

ECOLOGICAL RESTORATION PLAN FOR THE STUCKY RIDGE AND SMELTER HILL INJURED AREAS

January 2002

Submitted to:

Montana Department of Justice
Natural Resource Damage Program
Helena, Montana

Prepared by:

Bitterroot Restoration, Incorporated
Corvallis, Montana



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ABBREVIATIONS AND ACRONYMS

AERL	ARCO Environmental Remediation, LLC
ARCO	Atlantic Richfield Company
ARTS	Anaconda Revegetation Treatability Study
ARWWS	Anaconda Regional Water, Waste and Soils
AUDB	Agency Upland Design Basis
BA	Borrow Area
BMP	Best Management Practice
BRI	Bitterroot Restoration, Inc.
CEC	Cation Exchange Capacity
COC	Contaminant of Concern
DEQ	Department of Environmental Quality
EPA	Environmental Protection Agency
GIS	Geographic Information System
GPS	Global Positioning System
IA	Injured Area
LRES	Land Reclamation Evaluation System
M-WV	Monitor Well Vegetated
NA	No Action
NAR	No Action Rock
NPL	National Priority List
NRIS	Montana Natural Resource Information System
NRPD	Montana Department of Justice, Natural Resource Damage Program
PR	Previously Reclaimed
PTSG	Planting of Trees, Shrubs and Grasses
RA	Reference Area
RDU	Remedial Design Unit
ROD	Record of Decision
SH	Smelter Hill
SR	Stucky Ridge
SSR	Steep Slope Reclamation
T	Tillage
USGS	U.S. Geological Survey
VI	Vegetation Improvement
WV	Well Vegetated

SECTION 1

INTRODUCTION

Section 1: Introduction

Natural resources of the Stucky Ridge and Smelter Hill Injured Area (IA), including soils, vegetation, wildlife habitat, and wildlife, have been injured as a result of historical and continuing releases of hazardous substances from the mineral processing operations at the Anaconda Smelter. The Terrestrial Resources Injury Assessment Report Upper Clark Fork River NPL Sites (“Terrestrial Injury Report”) issued in 1995 states that the loss of a diverse and healthy plant community has resulted in the loss of viable wildlife populations typical of a southwest Montana upland habitat (Montana 1995). Restoration of a desirable native plant community is a key element for mitigating impacts to natural resources within this area. The purpose of this restoration plan is to examine alternative methods for site restoration, present a strategy for implementing restoration activities, and to provide cost estimates for ecological restoration of the IA.

The Montana Department of Justice, Natural Resource Damage Program (NRDP) proposes to assess natural resource damages of the IA through the development of a comprehensive ecological restoration plan. Restoration will focus on the re-establishment of a diverse native plant community and consist of the planting of trees, shrubs, grasses, and forbs on contaminated areas. Benefits to be derived from implementation of such a program will include:

- Restoration of cover and forage for large-game mammals that are currently transient visitors to the site (elk, black bear, others).
- Restoration of habitat suitable for non-game species absent from the IA due to metals contamination.
- Improved water quality in the associated drainages and waterways.
- Improved aesthetics and recreation opportunities for hunters, hikers, and other users of the site.

1.1 Goal Statement & Objectives of Ecological Restoration

1.1.1 Goal Statement

The Stucky Ridge and Smelter Hill IA Restoration Plan will identify measures to mitigate wildlife habitat loss resulting from hazardous substance contamination through the restoration of native vegetation.

1.1.2 Objectives

1. Convert areas that are presently metals impacted grasslands or devoid of vegetation into grasslands, shrub lands, or conifer forests with plant species composition and structural diversity comparable to baseline conditions.
2. Control erosion on degraded areas and consequently improve water quality and fisheries on associated waterways.
3. Minimize weed invasion onto barren and degraded areas throughout the site.
4. Eliminate visual blemishes (i.e., barren, eroding soils) on the IA landscape.

1.2 The Concept of Restoration

Restoration Ecology is an applied science concerned with renewing and maintaining ecosystem health (SER 1995). The US National Research Council (1992) broadly defines restoration as follows:

Restoration is defined as the return of an ecosystem to a close approximation of its condition prior to disturbance. In restoration, ecological damage to the resource is repaired. Both the structure and the functions of the ecosystem are recreated. Merely recreating the form without the functions, or the functions in an artificial configuration bearing little resemblance to a natural resource, does not constitute restoration. The goal is to emulate a natural, functioning, self-regulating system that is integrated with the ecological landscape in which it occurs. Often, natural resource restoration requires one of the following processes: reconstruction of antecedent physical hydrological and morphological conditions; chemical cleanup or adjustment of the environment; and biological manipulation, including revegetation and the reintroduction of absent or currently nonviable native species.

1.2.1 EPA Viewpoint

The Agency Upland Design Basis (AUDB) prepared by EPA's remedial contractor, Montana State University-Reclamation Research Unit (MSU-RRU), defines restoration in a more precise manner and recognizes the specific relationship between restoration, remedy, and the Record of Decision (ROD) (EPA 2001). The AUDB provides the following specific criteria to achieve restoration of the uplands area (p.23-24):

- *Vegetation quality exceeds remedy both in canopy coverage (>45%) and in diversity (>>5 species/100m²).*
- *Vegetation quality is minimally dependent on COC levels and strongly controlled by physical characteristics of the soil.*
- *Many species can grow in the soil including those native to the area prior to disturbance.*
- *Plant succession is possible in short periods of time (<20 years).*
- *Vegetation will be dominated by native forbs, grasses, shrubs, and trees much like the pre-disturbance plant community.*
- *Metals tolerant species are unimportant in the plant community.*
- *Vegetation must be established that mirrors the pre-disturbance wildlife habitat both in species diversity and structural diversity.*

1.2.2 Bitterroot Restoration, Inc. Viewpoint

Bitterroot Restoration, Inc.'s (BRI) view of restoration takes into account the concept of effectiveness as described by Higgs (1977) and Lockwood and Pimm (1999). Effective restoration has been defined as containing three components: 1) structural/compositional replication, 2) functional success, and 3) durability (Higgs 1997; Lockwood and Pimm 1999).

Structural/Compositional Replication. Structural/compositional replication is described in terms of similarity of plant species diversity (richness and abundance) between the reference area and restored area.

The AUDB sets criteria in which vegetation would be controlled by soil characteristics and would “mirror pre-disturbance wildlife habitat both in species diversity and structural diversity”. The Land Reclamation Evaluation System (LRES) is a system that evaluates present field conditions and recommends a remedial action for a specific area. The LRES treatments proposed in the Remedial Action Work Plans will result in a substantial reduction in the influence of metals on plant communities, but will only partially achieve the criteria of mirroring pre-disturbance wildlife habitat due to the limited nature of the revegetation plantings.

BRI recognizes the problematic nature of proposing to restore entire plant communities that “mirror pre-disturbance” conditions. This is referred to as the difference between “full” and “partial” restoration; full restoration being the re-introduction of the full compliment of species that originally inhabited a site while partial implies the re-introduction of a subset of species. The ability of any plan to succeed in full restoration of the IAs is questionable. Partial restoration of dominant or definitive species in the community, however, is obtainable (Lockwood and Pimm 1999).

In order to produce an effective structural/compositional replication, proposed actions for restoration should emphasize the planting of the broadest spectrum of site-adapted native plant species representative of the original plant community. Plant species should represent all life forms (trees, shrubs, grasses, forbs, and non-vascular plants) and different reproductive strategies such as wind and insect pollinated species. Also, actions should be taken to modify the physical and chemical characteristics of damaged soils in order to develop soil characteristics capable of supporting these species.

Functional Success. Functional success of restoration is measured by the presence of ecosystem processes, such as forage productivity, soil erosion, and loss or retention of nutrients (Lockwood and Pimm 1999).

The criteria set by the AUDB are implicit with respect to function. It is assumed that a 45% cover of native plant species with greater than 5 species/100m² will result in adequate forage production, erosion control, and cycling of nutrients. The proposed LRES treatments will

address these criteria to a point. For example, LRES will achieve erosion control on the site and provide for a limited level of forage through plantings of trees, shrubs and grasses (PTSG). It is not clear, however, if the addition of nutrients will result in sustained productivity or if cycling of nutrients will occur in soils that are largely microbially inactive.

In order to produce an effective functional restoration, proposed actions for restoration should include the re-introduction of mycorrhizal fungi in order to promote the effective utilization and cycling of nutrients. The addition of organic matter and repeat fertilization should occur to develop adequate nutrient reserves and soil structure for sustained productivity. A program relying upon single applications of nutrients and which does not address soil structure will likely not result in a functional community as measured by productivity or long-term erosion control.

Durability. Durability is the ability of the restored plant community to resist invasion, avoid excessive levels of extinction, and persist as succession will allow. Durability is influenced by natural phenomena such as drought and flooding and evidenced by reproduction of restored species. Restoration of a particular species composition that is not durable will be transitory and revert back to an unrestored state. Durability is generally measured through monitoring.

The criteria presented do not address the issue of durability. Although the word “sustainable” is utilized in the Preliminary Design Package to describe the proposed restoration plant community, the implication of durability is that the restored plant community would resist change. A criteria statement that identifies sustainability as the ability to “resist changes in species composition as influenced by drought, flooding, or weed seed presence” appropriately describes restoration in terms of time.

In order to produce a durable restoration, proposed actions should emphasize the control and elimination of non-native weedy species and extended planting efforts in order to promote the successful re-introduction and expansion of species. Also, repeat fertilization and re-introduction of microbial organisms to improve soil characteristics contribute to durability as described in the functional restoration section, Section 6 “Restoration Treatments and Specifications.”

1.3 Proposed Restoration Alternatives

BRI proposes three alternatives in order to achieve varying levels of restoration. Three separate alternatives have been developed which vary in intensity, length of time to baseline conditions, risk of continued site degradation, and cost. The alternatives considered are:

- ◆ No Action Alternative
- ◆ Active Restoration Alternative
- ◆ Intensive Restoration Alternative

No Action Alternative. The goal of this alternative will be to allow sites as treated by remedy actions to follow a natural recovery trajectory. This alternative assumes that remedy actions are successfully completed. The No Action Alternative will rely entirely upon natural recovery and could result in extended time towards recovery, a steady state consisting of the remedy revegetation effort, or a trajectory of site degradation with no or minimal recovery. This alternative recognizes the potential for remedy to succeed in partially restoring the potential ability of a site to recover naturally while accepting risks of failure or further degradation. This alternative will not actively pursue restoration and may not result in ecosystem health, richness of plant species, and diversity of structure similar to baseline.

Active Restoration Alternative. The goal of the Active Restoration Alternative will be to restore mid-successional plant communities and initiate a trajectory of recovery towards baseline. Components of this alternative include enhancement plantings which provide 5 additional species to site richness (5 species @ 100 stems/species=500 stems/acre), application of amendments to plantings, initial fertilizer application, possible lime treatments on steep areas, and maintenance as necessary. The focus of this alternative will be to increase species richness on sites. This alternative will rely heavily upon natural recovery, result in interim use by wildlife species adapted to edge communities, and an extensive time for complete restoration of natural resource characteristics of baseline conditions.

Intensive Restoration Alternative. The goal of the Intensive Restoration Alternative will be to restore mid- to late-successional plant communities and to initiate an accelerated trajectory of recovery towards baseline. This alternative recognizes the need to restore wildlife habitat consisting of mid- to late-successional plant species capable of supporting a variety of native plant, insect, avian, and mammal life. This alternative will rely upon intensive restoration efforts and minimize time for the restoration of wildlife habitat. Components of this alternative include enhancement plantings which provide 10 additional species to site richness (10 species @ 100 stems/species = 1000 stems/acre), sub-surface compost applications, augmentation of the existing seed mix, initial and maintenance fertilizer application, possible lime treatments on steep areas, and maintenance as necessary. This alternative places minor emphasis on natural recovery as a tool and will minimize the time required to create a sustainable plant community with wildlife habitat values similar to baseline.

Alternatives are further contrasted in Section 5.

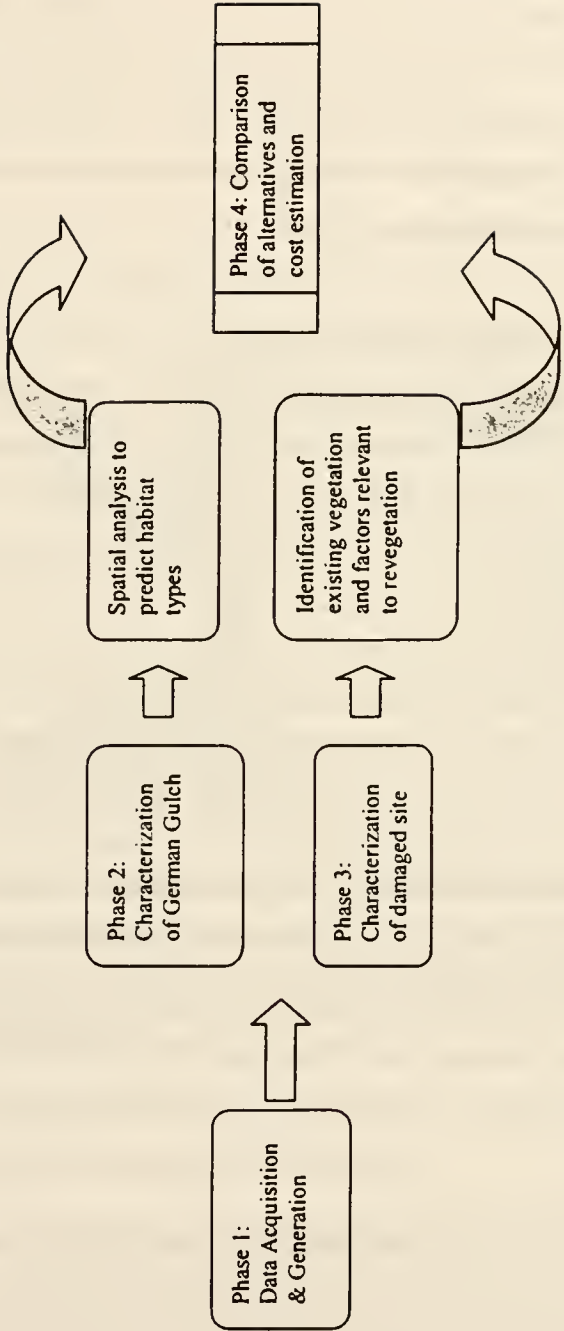
1.4 Restoration Planning Process

The Restoration Planning Process was devised to provide a logical framework for identifying restoration needs and developing alternatives. The Restoration Planning Process integrates in-field characterizations of site conditions with computer-based planning tools to allow for an effective and efficient means of quantifying restoration needs and costs for large areas. The process was designed to answer the following basic questions concerning restoration of the IA:

1. What species are appropriate to produce an effective restoration?
2. How should restoration species be distributed?
3. What are the methodologies and techniques necessary to overcome potential environmental and other obstacles on the site?
4. Are other alternative strategies available for achieving the same restoration goal?

The Restoration Planning Process proceeded in four phases as described in **Figure 1.4.1**. During Phase 1, data were generated and acquired to support subsequent phases. Phase 2 characterized the German Gulch reference site utilizing GIS technology and field evaluation in order to predict the natural vegetation of the IA. Phase 3 characterized current vegetation on the IA and identified factors that are relevant to revegetation. Phase 4 compared three alternative strategies for achieving restoration and quantified costs associated with restoration.

Figure 1.4.1. Planning Process Flow Chart



1.4.1 Phase 1: Data Acquisition & Generation

The purpose of Phase 1 was to identify and acquire spatial data sets for analysis of the German Gulch Reference Area (RA) and the IA. A substantial portion of this work was conducted during the development of the Mount Haggin Restoration Plan. Additional work was limited to identifying data gaps and obtaining data for the Anaconda Uplands IA, which are described below in **Table 1.4.1.1**. Data were generated in-house or acquired from two sources – the U. S. Geological Survey (USGS) and the Natural Resource Information System (NRIS).

Table 1.4.1.1. Spatial layers used in the analysis

Layer Description	Source
30 meter Digital Elevation Model (DEM)	USGS
Contours (5', 10', 50')	NRIS
Hydrography	NRIS (TIGER data)
Transportation	NRIS (TIGER data)
LRES subpolygons	ARCO/CDM
ARCO soil sampling points	ARCO/CDM
Injured area boundaries	NRIS
Land ownership	NRIS
Anaconda Land Use	NRIS
Transect lines	Generated in-house
Transect points	Generated in-house
Aspect map	Derived from USGS DEM
Slope map	Derived from USGS DEM

Geographic Information System (GIS) layers generated in-house (point and line transect layers) followed a predetermined protocol. These layers were used by field ecologists to study vegetation and habitat characteristics in a subset of treatment remedy subpolygons within the IAs. Transects were drawn such that they covered the maximum elevation range and traveled near or through ARCO soil sampling points within the subpolygons.

1.4.2 Phase 2: Characterization of German Gulch Reference Area

The purpose of Phase 2 was to determine which plant species to restore to the IA. Phase 2 was accomplished by characterizing patterns of native vegetation of the RA and developing a model which would predict the locations of native vegetation at the IA. Field sites were visited within the German Gulch RA and specific native plant associates

(or habitat types) were related to landscape features. In certain instances, existing data was utilized in lieu of field collected data. The relationship between the landscape position factors (elevation, aspect) was evaluated and a model that predicts where native vegetation would occur was developed for the IA.

1.4.3 Phase 3: Characterization of Remedial Design Units

The purpose of Phase 3 was to determine whether specific techniques or methods would be necessary to insure the successful restoration of the IA. Phase 3 was accomplished by characterizing factors relevant to restoration at the IA. Specifically, a systematic in-field evaluation of the Remedial Design Units (RDU) categorized site conditions such as the prevalence of competing vegetation, presence of noxious weed species, and the intensity of browse by animals (Table 1.4.3.1). The data were evaluated and utilized during the development of treatments to determine whether or not to apply specific restoration techniques such as browse protection or weed control.

Table 1.4.3.1. Measured factors and potential responses.

Factor	Response (techniques or method)
Plant Competition	Scalping, Herbicide Application
Noxious Weed Presence	Weed control techniques (biocontrol)
Browse	Browse Deterrents (chemical repellents, physical browse protection)
Erosion	Erosion Control Measures (coir wattles, blankets, tackifiers)
Ground Cover (plantability)	Plan Modification (site preparation, alter plant specifications)
Microsite Presence	Microsite Enhancement (log additions, physical environmental protection)
Soil Fertility	Fertilization

1.4.4 Phase 4: Comparison of Restoration Alternatives

The purpose of Phase 4 is to compare alternative strategies for achieving restoration goals. The development of alternatives recognizes that LRES remedy actions may achieve adequate restoration potential, natural recovery may substitute for active restoration efforts in certain instances, and that ecological or economic considerations may make active restoration efforts infeasible. Three separate alternatives that vary in

intensity, cost, and potential outcome were developed for each proposed RDU type. A comparison of alternatives, associated treatments, and cost on a per acre basis is included.

1.5 Stucky Ridge and Smelter Hill IA Restoration Plan

This IA Restoration Plan identifies the actions necessary to successfully restore wildlife habitat values associated with baseline conditions and is organized into the following sections:

- ◆ Section 1: Introduction. Goals, objectives and the planning process identified.
- ◆ Section 2: Project Setting. Identifies the general areas of interest, characteristics of the environment, and review of previous revegetation efforts and proposed LRES efforts.
- ◆ Section 3: Characterization of the Gulch Reference Area. An analysis of the field study, GIS spatial analysis, and proposed habitat suitability model for the IA.
- ◆ Section 4: Characterization of the Stucky Ridge and Smelter Hill Injured Areas. Present model of the IA with acreage of individual treatment types, predicted vegetation based upon RA with acreage, LRES acreage as forest/grassland by treatment, and contrast with predicted. Present the evaluation of factors, which may affect revegetation efforts.
- ◆ Section 5: Comparison of Alternatives. Review of alternatives with treatment matrix, prescriptions, potential effectiveness, potential impacts, and estimated costs.
- ◆ Section 6: Restoration Treatments and Specifications. Specifications to be used for the restoration alternatives are described.
- ◆ Section 7: Descriptions of Restoration Species. Plant materials with their associated wildlife and erosion control values are described.
- ◆ Section 8: Detailed Prescriptions and Costs. All costs associated with implementation of the restoration plan are identified.

All plant names listed within the text are common names with Latin names located in Appendix A.

1.6 Literature Cited

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SECTION 2

PROJECT SETTING

Section 2: Project Setting

2.1 Area of Interest

The Anaconda Regional Water, Waste and Soil Operable Unit (ARWWS OU) of the Anaconda Smelter National Priority List Site covers approximately 300 square miles in the southern Deer Lodge Valley and the surrounding foothills area (EPA and MDEQ 1998). The area of interest for this plan is a subregion known as the Injured Area (IA) (**Figure 2.1.1**). The IA referred to within this document consists of two sites: 1) Smelter Hill; and 2) Stucky Ridge. The reference area referred to within this plan is known as the German Gulch Reference Area (RA).

Smelter Hill is a 4,463-acre site¹ identified as part of the Smelter Hill Subarea within the ROD. Smelter Hill is located to the south of Anaconda and is directly adjacent to the former Washoe Smelter Facility. The ROD identifies the presence of widespread soil contamination in the Smelter Hill Subarea with elevated levels of arsenic, cadmium, copper, lead and zinc in surface soils. Elevated levels of arsenic, copper, and lead are periodically noted in the surface waters of Mill Creek. Elevated levels of arsenic and cadmium have been identified in portions of the bedrock aquifer.

Stucky Ridge is a 2,352-acre site² identified as part of the Old Works/Stucky Ridge Subarea. Stucky Ridge is located to the north of Anaconda and is adjacent to the Old Works processing facilities. Stucky Ridge is comprised of two separate sites known as Stucky Ridge and Stucky Ridge North (aka Lost Creek Uplands Area). For clarity, these areas are collectively termed “Stucky Ridge” within this document. Stucky Ridge is a low ridgeline to the north of Anaconda while Stucky Ridge North is a set of hills located to the north of Lost Creek Road. The ROD identifies contaminant levels that are phytotoxic to native plant species throughout this subarea and high rates of erosion and poor vegetation cover have resulted from this contamination. Surface water and bed sediment in Warm Springs Creek and Lost Creek periodically contain elevated levels of copper and lead. Portions of the alluvial aquifer contain elevated levels of cadmium, copper, and zinc. Portions of the bedrock aquifer contain elevated levels of arsenic.

¹ Listed as 4,463 planimetric acres (4,649 ground surface acres per NRIS memo 1/9/97).

² Listed as 2,352 planimetric acres ((2,408 ground surface acres per NRIS memo 1/9/97).

The German Gulch RA is identified as the German Gulch portion of Mount Haggin Wildlife Management Area and is located to the east of the IA. The RA contains a mixture of fescue grasslands, coniferous forests, and high alpine meadows. Vegetation reference sites were located along the Beaver Creek Road, west of the road along Whitepine Creek, and to the southeast of High Rye Guard Station.

2.2 Land Use & Ownership

Land use consists of grazing, open space, wildlife habitat, recreation and minor residential developments (**Figure 2.2.1**). Land ownership includes The Atlantic Richfield Company (ARCO), private landholders, and local, state, and federal entities.

2.3 Landforms & Soils

Anaconda is located in the Deer Lodge Valley north of the Anaconda Range and southeast of the Flint Creek Range. The landforms and soils of the IA are typical of intermountain valleys and mountain ranges throughout the west.

Smelter Hill is a mountainous site that extends to over 7,000 feet in elevation and drains eastward into its primary water feature, Mill Creek. Soils were developed on steeply sloping alluvial fans, colluvium, and bedrock of sedimentary and volcanic rock types (EPA and MDEQ 1998). Slopes range in grade from less than 10% to greater than 50%. Soils are generally thin and may contain a large percentage of rock fragments. Rock armoring has occurred in some areas as a result of past wind and water erosion.

Stucky Ridge consists of foothills that extend to approximately 6,000 feet in elevation. Perennial streams draining from the area are Lost Creek and Warm Springs Creek. Soils are highly variable with minimal soils in areas of bedrock outcrops, very gravelly shallow soils in steeper sloped hillsides, and deep soils in transition zones between upland and lowland areas (AERL 2001b). Soil texture varies from gravelly loam to sandy loam in uplands and from gravelly loam to silty loam in lowland areas. Rock armoring occurs as a result of past wind and water erosion.

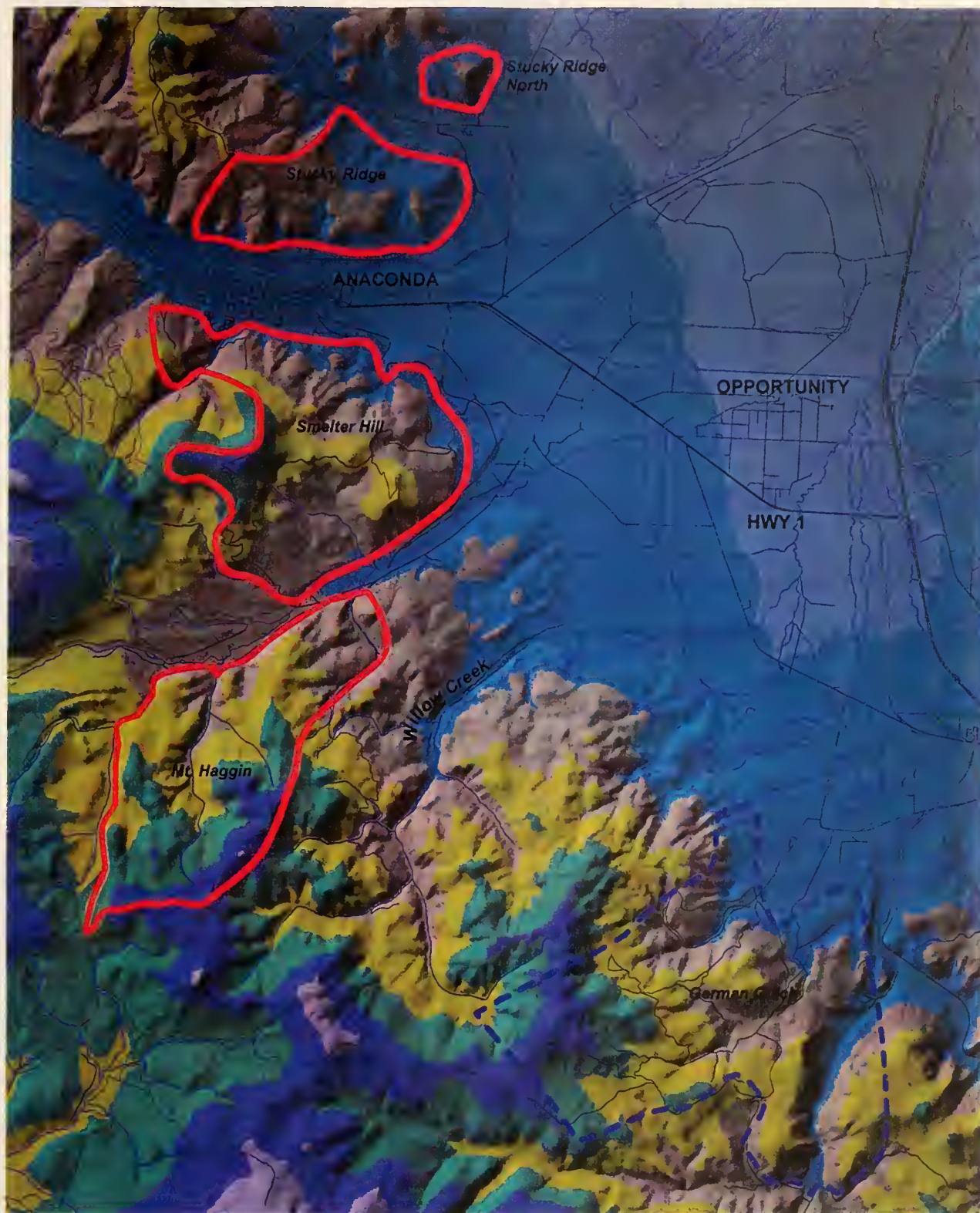


FIGURE 2.1.1

Area of Interest Overview Map

German Gulch Reference Area and Mt. Haggin, Smelter Hill, & Stucky Ridge Injured Area Locations



0 6000 12000 18000 Feet



- German Gulch Reference Area - BRI 2001
- Injured Area Boundaries
- Roads
- Streams and Rivers

Elevation Model

- 4500' - 5000'
- 5000' - 5500'
- 5500' - 6000'
- 6000' - 6500'
- 6500' - 7000'
- 7000' - 7500'
- > 7500'

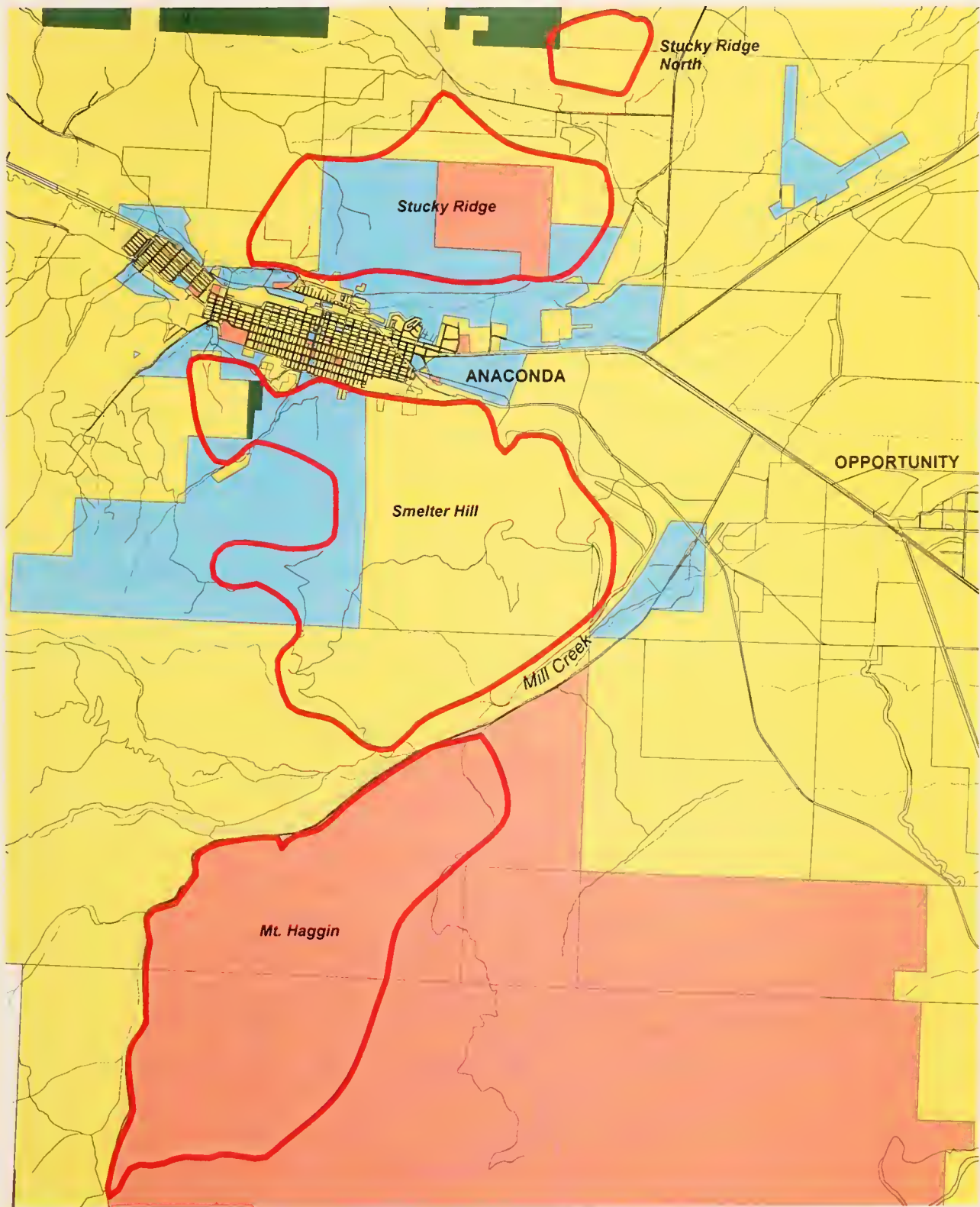


FIGURE 2.2.1

Overview Map of Land Ownership

Land ownership in the vicinity of the Mt. Haggin, Smelter Hill, & Stucky Ridge Injured Areas



0 4000 8000 12000 Feet



- Injured Area Boundaries
- Roads
- Streams & Rivers

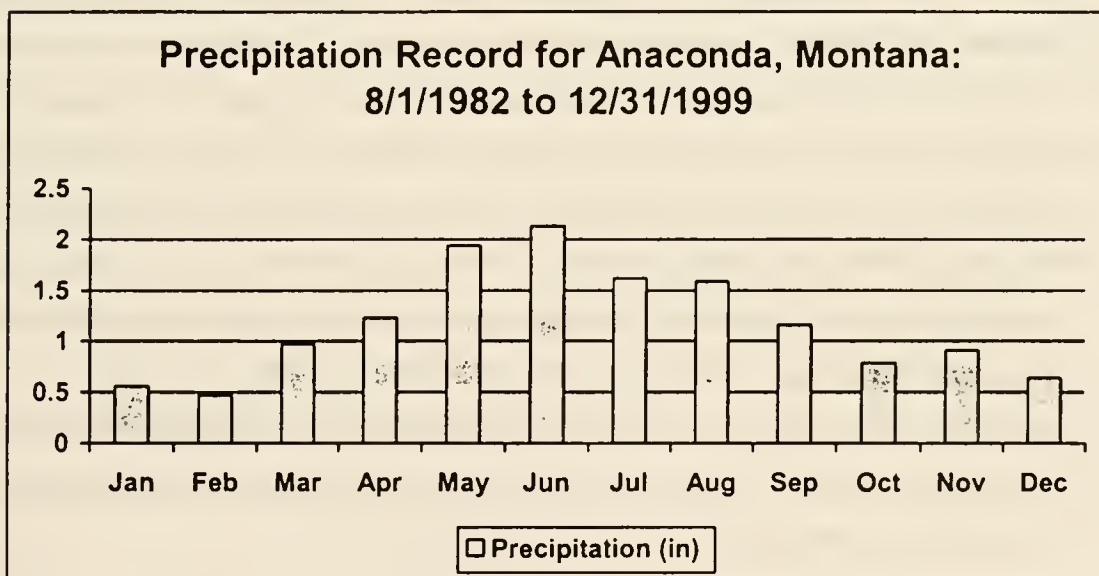
Land Ownership

- Federal
- State
- County
- Private

2.4 Climate

The Anaconda climate is semi-arid with moderate wind conditions, long cold winters, and cool summers (EPA and MDEQ 1998). Patterns of precipitation and temperature are described based upon the National Climatic Data Center site in Anaconda (elevation 5,511), the closest available climate data. The average annual temperature is 43°F. The warmest month is typically July (79°) and the coldest is January (14.5°) based on a 30-year mean maximum daily temperature. Mean annual precipitation is 14 inches with peak precipitation occurring during May (1.9") and June (2.3"). Mean annual snowfall is 63 inches based upon data collected from 1951 through 1974. In general, precipitation will increase with elevation and temperature and evapotranspiration will decrease between the Anaconda weather station and the upper elevations of the IA. Mean temperature follows a similar pattern with large daily fluctuations.

Figure 2.4.1. Precipitation record for Anaconda, Montana (WRCC 2000).



2.5 Wildlife

Wildlife resources found within the Anaconda Uplands are those adapted to semi-arid montane conditions and plant communities associated with such areas (Montana 1995). The RA contained abundant sign of elk, moose, and black bear associated with forest and forest openings.

Prominent bird species observed throughout the RA included Clark's nutcracker and red crossbill associated with coniferous tree canopies and mountain bluebird associated with forest edge and open habitats. Typical wildlife associated with these upland habitats include birds of prey, woodpeckers, songbirds, squirrels, porcupine, marten, black bear, moose, elk, deer, invertebrates, amphibians, and reptiles (EPA and MDEQ 1998). Riparian and wetland species found in undisturbed habitats include birds of prey, waterfowl, woodpeckers, songbirds, otter, muskrat, mink, raccoon, beaver, deer, amphibians, reptiles, and invertebrates (EPA and MDEQ 1998). The ROD indicates that federally endangered species such as the peregrine falcon and gray wolf and threatened species such as the bull trout may occur within the ARWWS OU. A complete list of mammals and birds characteristic of the IA prior to injury is located in **Appendix B**.

2.6 Native Plant Communities

Native plant communities of the RA are generally distributed across a moisture gradient. The moisture gradient across the area's complex mountain topography is best defined in terms of elevation, topographic-moisture, and soil characteristics. Elevation is the most widely recognized and consistent zone for classification of montane vegetation (Pfister, Kovalchik et al. 1977; Peet 1988). Zones recognized in order of increasing elevation for southwestern Montana include: 1) limber pine zone; 2) Douglas fir zone; 3) lodgepole pine zone; 4) Englemann spruce zone; and 5) sub-alpine fir zone (Pfister, Kovalchik et al. 1977). Also, fescue grasslands dominated by rough fescue and Idaho fescue are common within lowland and foothill areas (Mueggler and Stewart 1980; EPA and MDEQ 1998). In reality, all zones are not necessarily present within each region, nor do they occur strictly within the bounds of an elevation band. For example, northern aspects and high moisture availability tend to lower the elevation at which a particular zone may occur.

Elevation has a substantial effect on vegetation. As elevation increases, temperature drops, wind speed increases and snow depth and duration may increase which all affect soil moisture level and vegetation potential. In addition, the topographic-moisture gradient, or simply put, slope and landscape position, influences the distribution of vegetation. South-facing and ridge top sites are warmer and drier than north-facing slopes and valley bottoms. Also, upper slopes and

ridges shed water to lower slopes and valley bottoms, thus providing a net gain in moisture for lower areas. Major soil factors other than metals that influence vegetation are texture and depth, both of which affect water availability. In general, trees dominate thin or rocky soils, while grasses and forbs form highly competitive sods on deep, fine-textured soils (Peet 1988). Vegetation is generally layered with a tree overstory, shrub mid-story, and grass-forb understory.

2.7 Injury to Anaconda Uplands

Smelter emissions transported by air as well as by water and as fugitive dust arising from exposed tailings, are considered to be the primary sources of hazardous substances delivered to the IA (EPA and MDEQ 1998). These hazardous substances include oxides of arsenic, cadmium, copper, lead and zinc, as well as sulfurous compounds (EPA and MDEQ 1998).

2.7.1 Emissions History

The deposition of hazardous substances on the Uplands Area began in 1884 with the construction and operation of the Upper Works facility in Anaconda (Montana 1995; EPA and MDEQ 1998). This operation initially consisted of 26 reverberatory furnaces with individual stacks processing some 500 tons of ore per day. By 1889, the Upper and Lower Old Works were processing 4,000 tons of ore per day. In 1902, the Anaconda Smelter began operations, tripling production to 12,000 tons of ore per day (Montana 1995). A 1907 study (Montana 1995) measured the following average daily release of hazardous material from the Anaconda Smelter:

➤ Arsenic trioxide	29.7 tons/day
➤ Copper	2.2 tons/day
➤ Lead	2.4 tons/day
➤ Zinc	3.1 tons/day

Between 1911 and 1916, average arsenic discharge from the Anaconda Smelter ranged from 40 to 62 tons per day (Anaconda Smelter Smoke Commission n.d. as cited in (Taskey 1972) while between 1914 and 1918, arsenic emissions were estimated at 75 tons per day (Wells 1920 as cited in (Taskey 1972).

Data from October 1976 showed the following daily emissions of hazardous material from the main chimney at Anaconda Smelter (Montana 1995):

➤ Arsenic	6.1 tons/day
➤ Copper	5.2 tons/day
➤ Lead	1.8 tons/day
➤ Zinc	2.2 tons/day

A variety of smelter emissions continued to impact the Anaconda Uplands until the closure of the Anaconda Smelter in 1980 (Montana 1995).

2.7.2 Impacts to Stucky Ridge and Smelter Hill Injured Area

Water quality data indicate that smelter emissions on upland areas have impacted water quality within the IA. Water samples collected from IA water features following summer rainstorm events consistently exceeded human health and aquatic life standards for arsenic during sampling in 2001 (CDM 2001). In addition, copper, lead, zinc and cadmium all exceeded health and aquatic life standards in certain instances (CDM 2001). These water sample results indicate that a source of heavy metals exists in eroding uplands areas and continues to impact the water quality of perennial streams draining the IA.

Soils from the IA have been determined to be phytotoxic as a result of smelter emissions (Montana 1995; EPA and MDEQ 1998). Further, trace element loading has directly injured vegetation in the upland areas and drastically altered vegetative communities from their original form. The following impacts are the result of smelting activities:

- The ROD notes that smelting and other activities have resulted in the total elimination of native plant communities and extensive topsoil loss resulting from the lack of vegetation within the vicinity of Stucky Ridge, Smelter Hill, and Mount Haggin.

- A distinct shift in plant communities has occurred in which forests have been converted to grasslands dominated by metal-tolerant plant species (Montana 1999). Metal tolerant redtop and basin wildrye as well as noxious weeds currently dominate grasslands previously dominated by rough fescue and Idaho fescue. Riparian areas associated with intermittent streams are typically dominated by aspen which spread by rhizomes underneath the zone of contamination.
- The shift in plant communities has resulted in a loss of habitat availability and suitability (Montana 1995).
- As a result of the loss and degradation of habitat, many wildlife species have been lost from the IA or undergone population reductions (**Table 2.7.2.1**) (Montana 1995).

Table 2.7.2.1. Bird and mammal populations that are likely to have been lost or suffered reduced viability due to removal of tree canopy, bole, shrub midstory, understory, and terrestrial subsurface habitat layers in upland impact areas (Montana 1995).

Reduced Viability	Species Lost	
Swainsons thrush	Red-tailed hawk	Red-breasted nuthatch
American robin	Sharp-shinned hawk	House wren
Chipping sparrow	Cooper's hawk	Ruby-crowned kinglet
White-crowned sparrow	Northern goshawk	Mountain bluebird
Dark-eyed junco	Blue grouse	Townsend's solitaire
Black bear	Spruce grouse	Cedar waxwing
Ermine	Northern saw-whet owl	Yellow-rumped warbler
Snowshoe hare	Downy woodpecker	Pine grosbeak
Mountain lion	Hairy woodpecker	Red crossbill
Bobcat	Olive-sided flycatcher	Pine siskin
Elk	Western wood-pewee	Evening grosbeak
	Grey jay	Red squirrel
	Stellar's jay	Porcupine
	Clark's nutcracker	Pine marten
	Mountain chickadee	Lynx

- The Terrestrial Damage Report (Montana 1995) concludes that “The ability of the injured upland areas to revegetate and provide wildlife habitat is precluded by phytotoxic levels of hazardous substances in soils. Throughout much of the injured upland area, current injuries are likely to persist indefinitely without restoration.”
- Furthermore, the AUSB concludes that “Despite ongoing natural recovery of desirable vegetation, infestation of the site by weeds and continued releases of contaminants of concern (COC) from barren and sparsely vegetated land suggest that ecological conditions are degrading or stagnant within the other areas of the site” (EPA 2001).

2.8 Previous Revegetation Efforts

Since the early 1960s, sporadic attempts have been made to revegetate impacted areas around Anaconda. Between 1960 and 1967, the Anaconda Mining Company planted more than 60,000

Douglas fir and lodgepole pine on the A Hill above Anaconda, in Sheep Gulch and near Mill Creek (NPI n.d.). Another 16,500 lodgepole pine, ponderosa pine and other trees were planted by the Anaconda Mining Company in Sheep Gulch and on the A and C Hills above Anaconda between 1971 and 1977. While the specific planting sites of these initiatives are unknown, the marginal success of the replanting efforts and continued problems with soil erosion resulting in additional replanting efforts beginning in 1985 (Andreozzi 1993).

Between 1985 and 1992, crews hired by the Anaconda City-County Government planted 191,430 tree seedlings on 549 acres and an additional 51,551 shrubs over 83 acres on the A and C Hills (Andreozzi 1993). In addition, approximately 28,000 trees were planted by local schools and community groups on 31 acres. After 8 years, monitoring showed a 64% survival rate across all species, or approximately 223 surviving seedlings per acre. This work indicates that while revegetation may be challenging on the IA, it is feasible.

The Anaconda Revegetation Treatability Study (ARTS) was conducted between 1992 and 1997 to develop in-situ technologies (MSU-RRU 1997). The ARTS study entailed laboratory and greenhouse evaluation of soil treatments, amendments, and species-specific plant responses. The final phase of the ARTS study provided for the implementation of pilot scale demonstration plots on two upland areas. The Smelter Hill study site (Field Site 9) was treated with applications of lime, fertilizer and manure (organic matter) incorporated at various depths. The site was seeded and planted with live seedlings. The Dragstrip Area (Field Site 13) was treated with organic matter, lime, and deep plowing. The treatments applied to both areas resulted in establishment of acceptable vegetation cover and production, a reduction in surface water runoff volumes along with improvements in runoff water quality, a sharp decrease in offsite transport of contaminants of concern (COC), and an increase in precipitation infiltration and a reduction in percolation. Key components of revegetation success were lime addition for pH control, organic matter for soil improvement, fertilization; and species selection based upon metals tolerance.

2.9 Proposed Remedy Actions

ARCO Environmental Remediation, L.L.C. (AERL) has developed preliminary design packages, remedial action work plans and storm water control plans for large-scale reclamation on Stucky Ridge, Stucky Ridge North (aka Lost Creek), Smelter Hill, and Mount Haggin (AERL 2002, 2001a,b,c,d,e,f,g,h,i,j) . The goal of these plans is to achieve remedy as required by the ROD. Key components identified in the AUSB for successful reclamation include pH control, rootzone thickness, organic matter, vegetation selection, and other factors related to soil chemistry and application techniques.

The four basic revegetation remedies to be applied to remedy areas (see **Figure 2.9.1**) as proposed within these draft Remedial Action Work Plans³ are as follows:

1. Well-vegetated (WV) or No Action (NA) Areas—These areas will receive no treatment, other than weed control efforts as necessary.
2. Steep Slope Reclamation (SSR) Areas—These areas consist of slopes steeper than 3:1. Remedial actions will include PTSG as well as on-slope best management practices (BMP) (i.e.-brush boxes and dozer basins). Tree and shrub plantings will consist of 500 stems per acre including a 25% mortality factor. Four specific techniques have been identified: 1) SSR-1—Hand broadcast seeding in conjunction with planting of trees and shrubs; 2) SSR-2—Hand broadcast seeding in conjunction with trees and shrubs, and implementation of on-slope BMPs that do not require mechanized equipment; 3) SSR-3—Hand broadcast seeding in conjunction with planting of trees and shrubs, and implementation of on-slope BMPs requiring mechanized equipment; and 4) SSR-4—Hand broadcast seeding in conjunction with planting of trees and shrubs, and implementation of on-slope BMPs requiring mechanized equipment and slope regrading/recontouring.

³ These draft work plan design maps, as developed by ARCO, have been slightly modified in this figure based upon instruction from the NRD Program. About 800 acres in the northern Smelter Hill area are shown to have treatments different from those in the ARCO design maps based on the opinion of the NRDP that the final design will reflect these changes. About 600 acres are expected to change from M WV to SSR or Tillage and approximately 200 acres have been identified as aspen and will receive no restoration treatments.

3. Tillage Treatment Areas (T6 and T12)—In general, these areas are poorly vegetated, have low pH, elevated metal and/or arsenic levels, and slow rates of natural recovery. This technique will consist of tilling to the depth of 6 or 12 inches based upon soil pH and existing COC concentrations. Amendments (liming and/or organic matter application) will be applied and the area drill seeded. Organic matter will be applied in very limited areas at a rate of 0.5% in the top 4 inches in instances where COC concentrations are elevated above soil metal concentrations as set by ARCO or soils are sandy textured after tilling. Areas of existing trees and acceptable vegetation will not be tilled. Also, crimped or mulched straw at a rate of one ton per acre will be applied to transition zones above SSR areas.
4. Vegetation Improvement (VI) Treatment Areas—These areas contain some vegetation and have the potential for natural recovery. A minimal level of treatment is proposed. Four specific techniques have been identified: 1) VI-1—Weed spraying, as necessary, light tilling (4- to 6-inches) with possible lime and/or fertilizer and drill seeding of the area; 2) VI-2—Weed spraying, as necessary, surface scarification with possible amendments including lime and/or fertilizer application and drill seeding; 3) VI-3—Weed spraying, as necessary and scarification of the soil surface with broadcast seeding and fertilization; and 4) VI-4—Weed spraying, as necessary; broadcast seeding and/or broadcast fertilization.

The principal objective of these efforts will be to stabilize contaminated and eroding soils through the establishment of metal tolerant vegetation with minimal diversity (EPA 2001). The anticipated results of this effort are a minimum of 45% vegetation cover and approximately 5 species per 100 meter². Plant species established will be predominantly wind pollinated trees, early and mid-successional shrubs, drought and metal tolerant grasses, and early successional forbs. Vegetation will harvest infiltrating precipitation, reduce wind and water erosion, reduce COC exposure to wildlife, and be consistent with anticipated future land use.



FIGURE 2.9.1

Overview Map of Upland Remedy Treatments

Mt. Haggin, Smelter Hill, & Stucky Ridge Injured Area Locations



0 5000 10000 Feet



2.10 Relationship of Proposed Remedy Efforts to Restoration

The AUSB recognizes that “remedy...will only meet the Remedial Action Goals and Objectives as stated in the ROD, thereby falling short of a restored condition (EPA 2001).” BRI recognizes that the remedy effort will provide site stability, reduced exposure to wildlife, and sustainable vegetation cover, but also believes that a restored condition will not be met. Also, BRI recognizes that:

- Plant species richness resulting from remedy will be substantially lower than a baseline ecosystem. The vegetation resulting from the work plan focuses primarily on early successional and easily established species and fails to address species that previously dominated the site such as rough fescue.
- Plant species abundance resulting from remedy will be substantially lower than a baseline ecosystem. For example, a planting density of 500 plants per acre will not result in the abundance of wildlife forage or cover found under baseline conditions.
- Plant species structure will not necessarily replicate that previously present under baseline conditions. For example, the proportion of forest to grassland will not necessarily represent baseline conditions (See Figure 3.6.3.1 and Figure 3.6.3.2).

Secondly, BRI recognizes that further efforts could be initiated which would reduce the time to baseline and improve current conditions on the IA. Specifically,

- Restoration enhancement plantings that represent mid- to late-seral stages and increase plant species richness, abundance, and structure can be implemented.
- Soil structure can be modified to create conditions that would support a greater variety of plant species and reduce the time required for plant succession.
- Amendments such as lime can be applied to steep slope treatment areas which would consequently reduce the influence of COC on plant community development.

- The proposed fertilization practices can be modified in order to more effectively build nutrient resources within the soil and to favor native perennial species.

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SECTION 3

CHARACTERIZATION OF THE GERMAN GULCH REFERENCE AREA

Section 3: Characterization of the German Gulch Reference Area

3.1 Reference Area Characterization

The German Gulch RA was surveyed to determine the diversity of vegetation habitat types and the distribution of specific plant species that are expected to have been present on the IA prior to historic smelting-related disturbances. The survey was conducted using a reconnaissance method known as “habitat typing.” The purpose of habitat typing at German Gulch was to observe habitat types on specific landscape positions in order to provide a habitat suitability model or “template” for restoration prescriptions.

The following procedures were utilized to develop this habitat suitability model:

- The diversity and distribution of habitat types were observed through a field investigation of the German Gulch RA.
- Existing habitat types were described based upon field observations and published reference material.
- A habitat suitability model was developed that describes both the distribution of existing habitat types at German Gulch and predicted (restored) vegetation at the IA.

Specific details of these procedures are further described within this section.

3.2 The Habitat Type Concept

Habitat type classification is a land classification system based upon the potential vegetation of a particular landscape (Pfister, Kovalchik et al. 1977). As a tool, habitat types provide restoration ecologists and planners with the ability to understand site environmental factors that impact plant growth and to choose plant species appropriate for restoration of a site. The integrated nature of environmental variables and habitat types allows for large areas to be effectively described and delineated with respect to their vegetation potential.

Habitat typing is conceptually based upon the theory of succession in ecology (Pfister, Kovalchik et al. 1977; Ricklefs 1979). Succession describes a predictable progression of changes in vegetation within a landscape. Progressive stages are termed “seral” stages with a “climax”¹ or final vegetation type dominating a site at the end of succession. An example of this process would be the progression of a logged forest proceeding through an initial seral stage dominated by annual grasses followed by the encroachment of shrubs. Shrubs would subsequently be replaced by seral tree species adapted to dry open growing conditions followed by succession to a stand of “climax” forest tree species adapted to shade.

A “habitat type” is described as “all land areas potentially capable of producing similar plant communities at climax” (Pfister, Kovalchik et al. 1977). Thus, by observing the vegetation growing within an area, the user is able to identify several environmental factors influencing vegetation on the site and is theoretically able to predict which native plant species will (should) eventually grow on a site. Habitat types are named based upon the dominant overstory and understory plant species that are (or would be) present in the climax plant community. For example, a habitat type dominated by Douglas fir in the overstory and pinegrass in the understory is referred to as a “Douglas fir/ pinegrass habitat type.” This naming convention will be adhered to throughout this report.

Pfister notes that habitat types “reflect the most meaningful integration of the environmental factors affecting the plant community.” The three most meaningful variables associated with the occurrence of habitat types in mountainous regions are slope, aspect, and elevation (Peet 1988) (Pfister, Kovalchik et al. 1977). Elevation strongly influences moisture availability for plant growth due to cooler temperatures and higher precipitation rates at higher elevations. In addition, slope and aspect influence moisture availability. For example, southern exposures and steep topography are susceptible to drying and drainage while northerly exposures and flat topography limit the amount of evapotranspiration from a site. A fourth factor, soil type, influences moisture retention. Coarse-textured soils, for example, drain readily and are prone to drought conditions

¹ The authors recognize “climax” as a dated term, but utilize it to remain consistent with Pfister’s terminology. See (Ricklefs 1979) page 733.

whereas fine-textured soils with higher levels of clay and silt retain moisture that is more available for plant use. Habitat types, thus, reflect the integration of these environmental variables.

Habitat type classification has resulted in the development of field manuals with dichotomous keys used for describing the vegetation potential of a region of land. Habitat typing manuals have been created for and are in use by National Forests in several Western states (Youngblood and Mauk 1985; Hoffman and Alexander 1987; Mueggler 1988). In Montana, three separate classifications have been developed for separate cover types: 1) Forest habitat types have been described by Pfister (Pfister, Kovalchik et al. 1977); 2) Grassland and shrubland habitat types in western Montana have been classified by Mueggler (Mueggler and Stewart 1980); and 3) Riparian habitat types have been classified by Hansen (Hansen, Pfister et al. 1995). The Pfister and Mueggler references were used during our investigation of the RA.

3.3 Methods for Determining Diversity & Distribution of Habitat Types

Sampling Year 2000

Site reconnaissance and habitat typing occurred from May 17-19, 2000 and again on June 15, 2000 in order to assess the diversity and distribution of habitat types within the RA. A total of 73 observations were recorded along seven separate routes (**Figure 3.3.1**). Routes were located within various combinations of elevation and aspect gradients, both site factors understood to dictate the occurrence of habitat types. Routes were predetermined in the office, using the GIS maps to locate sites based upon combinations of the above site factors, with particular attention to sites that would correspond well to the occurrence of those conditions at the IA. Some routes were then adjusted in the field upon observing stand conditions and local topography.

Observations were made as follows: Upon leaving a staging area, the vegetation composition was observed at several elevations, aspects, and landscape features. Observation sites were located by selecting distinctive vegetation stands as elevation, aspect, and landscape features changed along the sampling route. Within a distinct stand of vegetation, species composition was compared to dichotomous keys in either of the two habitat typing manuals previously referenced (Pfister, Kovalchik et al. 1977; Mueggler and Stewart 1980). The identified habitat type was entered onto

a field data recorder, as were corrected Global Positioning System (GPS) coordinates of the individual survey location. Also recorded at each location were observations of the slope, aspect, elevation, soil texture (upper 6 inches), rock shape, and rock abundance on the ground surface (Table 3.3.1). Surface soil texture was determined by scraping back the overlying organic layer (if any) and utilizing the hand texturing method (Singer, Munns 1991). Soils falling within the sandy, loamy sand, and sandy loam texture classes (< 2 mm size fraction) were termed as “coarse.” All other soils were termed as “fine.”

Landform was determined based upon the topographic features listed in the Montana Habitat Type Field Form (Pfister, Kovalchik et al. 1977). Features noted were “ridge,” “upper slope,” “mid slope,” “lower slope,” “bench or flat,” and “stream bottom.” Rock shape was determined by observing the angular nature of the rock and percent rock cover was recorded using a modified classification system. Slope and aspect were calculated in the office using a GIS analysis of the digital elevation model data for the sites surveyed.

Table 3.3.1. Field data collection parameters.

<i>Parameter</i>	<i>Attribute</i>
GPS Position	Montana State Plane Coordinate
Habitat Type	Refer to Mueggler and Pfister
Soil Texture (< 2 mm size)	Coarse/Fine
Rock Shape on ground surface	Rounded/Angular
Percent Rock Cover on ground surface	0-5%/ 5-35%/ 35-70%/ 70-100%
Landform	Stream bottom/bench or flat/lower slope/ mid-slope/ upper-slope/ ridge

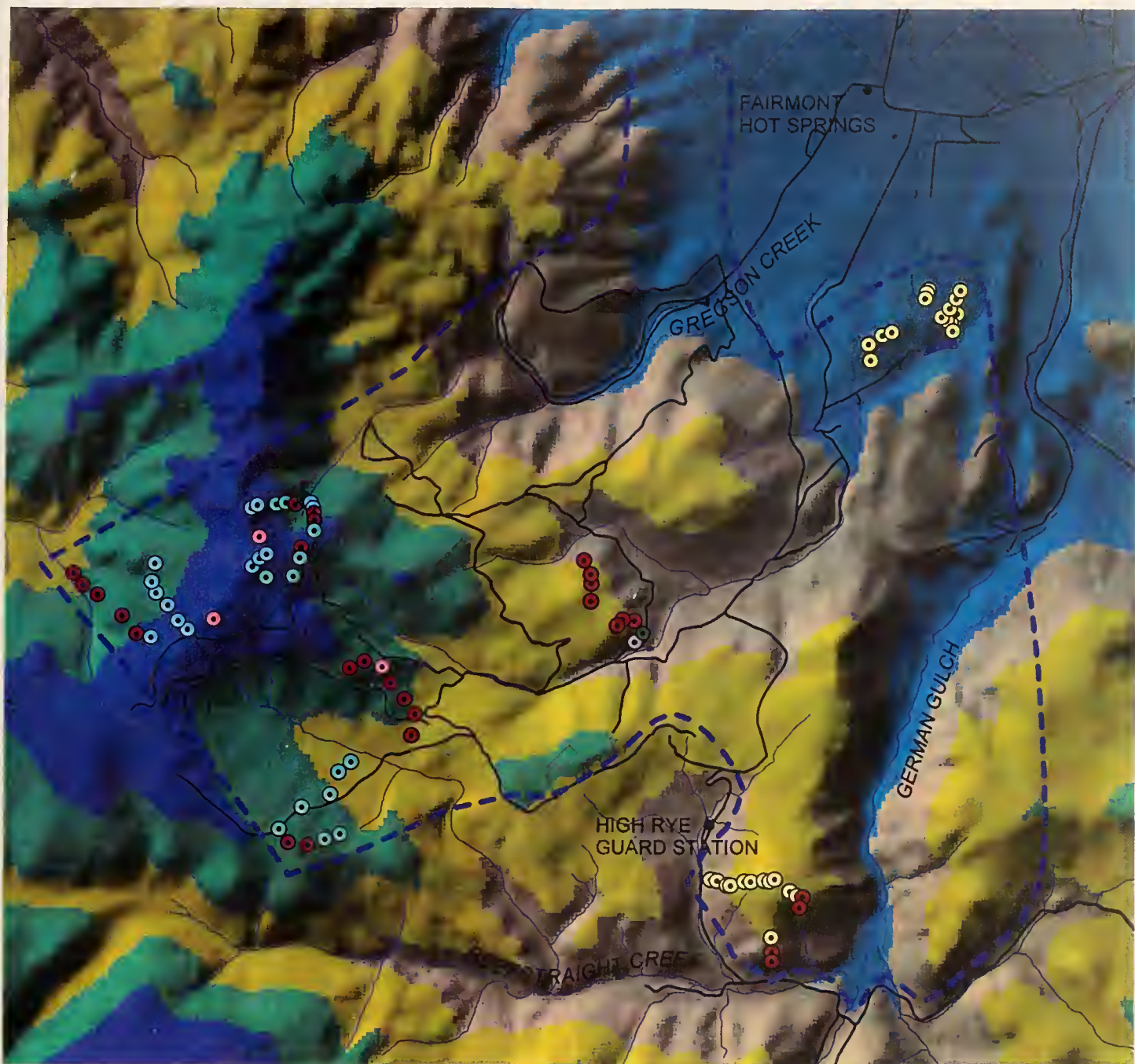


FIGURE 3.3.1

German Gulch Reference Area Survey Locations

Field investigations conducted Summer, 2000 and 2001 by BRI



0 2000 4000 6000 Feet



German Gulch Boundary (BRI, 2001)

Lakes and Reservoirs

Streams and Creeks

Roads

Reference Area Survey Locations (BRI, 2000-01)

Douglas Fir (Xeric) Habitat

Fescue Grassland (Xeric) Habitat

Fescue Grassland (Mesic) Habitat

Lodgepole Pine Habitat

Subalpine Fir Habitat

Douglas Fir (Mesic) Habitat

Bitterbrush Habitat

Elevation Model

5000' - 5500'

5500' - 6000'

6000' - 6500'

6500' - 7000'

7000' - 7500'

> 7500'

Prior to further analysis, habitat types were aggregated according to their habitat type series (i.e. - dominant tree species). In this report, these are subsequently referred to as the habitat types for the sake of clarity although they in actuality represent a habitat type “series.” Environmental factors evaluated were the separate classes of elevation, aspect, slope, soil texture, percent rock cover, landform and a newly generated factor termed “moisture regime.” Moisture regime was created by combining the unique combinations of the elevation and aspect variables. For example, “Moisture regime #1= elevation 5500-6000, north aspect” and “moisture regime #2=elevation 5500-6000, east aspect,” etc.

Environmental factors influencing dominant habitat types were evaluated using techniques called Crosstabulation Analysis and Chi-Square Test (Manuganistics 1994). The Crosstabulation Analysis was used to understand patterns of association between measured environmental variables and habitat types. Specifically, the Crosstabulation Analysis created a two-way table that arranged data so that each cell represents a unique combination of the values of the habitat type-environmental variables and the number of observations that fall into each combination of values. A Chi-Square Test was used to test the hypotheses that the observed habitat type and the measured environmental variable were independent. When the Chi-Square Test indicated that variables were related ($p < 0.05$), a Mosaic Plot was created to visually represent the environmental breaks that determined the habitat types. These breaks were recorded and incorporated as parameters for spatial analysis modeling.

Sampling 2001

Further sampling was conducted in June 2001 in order to assess low elevation grassland sites. A total of 5 observations were recorded along 5 separate routes within a low elevation site dominated by grasslands. Routes were located within various combinations of elevation and aspect gradients. Species canopy coverage data was collected utilizing the field forms developed for data collection described in Section 4. Mueggler and Stewart (1980) was used to identify the habitat types which occurred within this area. Their respective aspects and elevations were incorporated into the spatial model.

3.4 Habitat Typing Results

A total of 18 habitat types were observed at German Gulch RA (**Table 3.4.1**). Of the 18 sites, 14 were tree-dominated, 3 were grass-dominated, and 1 was shrub-dominated. The dominant forest habitat types occurring are Douglas fir/pinegrass, subalpine fir/grouse whortleberry, lodgepole pine/grouse whortleberry, Douglas fir/elk sedge, lodgepole pine/twinflower, Douglas fir/bluebunch wheatgrass. Dominant grass habitat types occurring are Idaho fescue/bluebunch wheatgrass, rough fescue/bluebunch wheatgrass, and rough fescue/Idaho fescue. The only shrub-dominated habitat type was bitterbrush/bluebunch wheatgrass.

The Crosstabulation and Chi-Square analysis of the 2000 sampling data determined that moisture regime, elevation, aspect, and soil texture were the best predictors of habitat series on German Gulch. Moisture regime, as stated previously, was a combination of the elevation and aspect classes and provided the most useful variable for incorporation into the spatial analysis model (**Section 3.6**). The recognition of moisture as the dominant variable determining habitat types concurs with the current literature for the northern Rocky Mountains (Pfister, Kovalchik et al. 1977; Peet 1988). Soil texture, while significant, provided limited utility in that it only allowed for the differentiation between grassland and forested habitat types.

Table 3.4.1. Habitat types arranged by dominant lifeform in order of decreasing moisture requirement.

<u>Tree-dominated Habitat Types</u>
Subalpine fir/ menziesia
Subalpine fir/ Sitka alder
Subalpine fir/ beargrass
Subalpine fir/ grouse whortleberry
Subalpine fir/ pinegrass
subalpine fir/ elk sedge
Lodgepole pine/ twinflower
Lodgepole pine/ grouse whortleberry
Lodgepole pine/ pinegrass
Douglas fir/ dwarf huckleberry
Douglas fir/ snowberry
Douglas fir/ pinegrass
Douglas fir/ elk sedge
Douglas fir/ bluebunch wheatgrass
<u>Grass-dominated Habitat Types</u>
Rough fescue/ Idaho fescue
Idaho fescue/ bluebunch wheatgrass
Rough fescue/ bluebunch wheatgrass
<u>Shrub-dominated Habitat Types</u>
Bitterbrush/ bluebunch wheatgrass

3.5 Description of Habitat Types

The following habitat type descriptions are arranged from highest elevation series (subalpine fir) to lowest elevation series (bitterbrush). Within a series, specific habitat types are arranged in order of highest relative frequency to lowest frequency. Wildlife use by several dominant species is summarized in Section 7.

3.5.1 Subalpine Fir Series

3.5.1.1 Subalpine Fir/ Grouse Whortleberry (*Abies lasiocarpa/ Vaccinium scoparium*) Habitat Type. Subalpine fir/ grouse whortleberry was the dominant habitat type of this series observed at German Gulch, occurring on 11.2 % of the sample sites. This is a common habitat type east of the Continental Divide on broad ridges, gentle slopes, and benches on north and west slopes above 6,500 feet in elevation (Pfister, Kovalchik et al. 1977). Subalpine fir/ pinegrass and Douglas fir/ pinegrass habitat types often occur on adjacent drier sites. This habitat type is considered to be one of the drier habitat types of the subalpine fir series.

Other tree species occurring within this habitat type include lodgepole pine, Engelmann spruce, and Douglas fir. Undergrowth species noted as occurring in this habitat type include grouse whortleberry, pinegrass, elk sedge, woodrush, and *Arnica* species.

3.5.1.2 Subalpine Fir/ Menziesia (*Abies lasiocarpa/ Menziesia ferruginea*) Habitat Type.

Subalpine fir/ menziesia occurred only once within sample sites. Pfister notes this habitat type as occurring on moist, highly sheltered slopes at higher elevations. In general, no bare soils or exposed rock occur under this habitat type. This habitat type is commonly associated with non-calcareous soil types.

Other common tree species located within this habitat type are Engelmann spruce, lodgepole pine, and Douglas fir. Shrub diversity on this site was substantially greater than on the drier grouse whortleberry habitat type. Pfister lists the subalpine fir/ menziesia habitat type as containing Sitka alder, globe huckleberry, grouse whortleberry, beargrass, and mountain arnica. Pyrola and round-leaved yellow violet are characteristic herbs.

3.5.1.3 Subalpine Fir/ Sitka Alder (*Abies lasiocarpa/ Alnus sinuata*) Habitat Type. Sitka alder habitat type was noted in scattered stands on isolated benches or where topography allowed for the accumulation of moisture. Pfister describes it as preferring cool and moist upland habitats at elevations between 6,500 feet and 7,500 feet in elevation. Soils are generally non-calcareous with little or no exposed bare soil and a prominent duff layer.

Other tree species occurring within this habitat type include lodgepole pine, Engelmann spruce, and Douglas fir. Undergrowth species noted as occurring in this habitat type include grouse whortleberry, globe huckleberry, and beargrass with scattered pyrola and mountain arnica.

3.5.1.4 Subalpine Fir/ Beargrass (*Abies lasiocarpa/ Xerophyllum tenax*) Habitat Type. The subalpine fir/ beargrass habitat type occurred only once within the sample sites. Pfister describes this habitat type as common west of the Continental Divide where it is associated with steep dry exposures at elevations between 5,200 feet and 7,000 feet. Soils are generally non-calcareous with little rock or bare ground exposed and a developed duff layer.

Seral tree species that may occur in this habitat type include lodgepole pine, Engelmann spruce, and Douglas fir. Undergrowth species noted as occurring in this habitat type include grouse whortleberry, globe huckleberry, beargrass, pyrola, and mountain arnica.

3.5.1.5 Subalpine Fir/ Pinegrass (*Abies lasiocarpa/ Calamagrostis rubescens*) Habitat Type. The subalpine fir/ pinegrass habitat type occurred only once within the sample sites. Pfister describes this habitat type as warm dry extreme of the subalpine fir series. As Pfister describes this habitat type as generally occurring on limestone substrates east of the Continental Divide, its presence at German Gulch is anomalous.

Seral tree species that may occur in this habitat type include lodgepole pine, Engelmann spruce, and Douglas fir. Undergrowth species noted as occurring in this habitat type include elk sedge, grouse whortleberry, globe huckleberry, western meadowrue, sweet-cicely, and pyrola.

3.5.1.6 Subalpine Fir/ Elk Sedge (*Abies lasiocarpa/ Carex geyeri*) Habitat Type. The subalpine fir/elk sedge habitat type occurred only once within the sample sites. This habitat type is

considered a dry site type of the subalpine fir series. Pfister notes it as a minor habitat type at higher elevations. Soils are both non-calcareous and calcareous with little exposed rock or bare ground and a developed duff layer.

Seral tree species that may occur in this habitat type include lodgepole pine and Douglas fir. Undergrowth species noted as occurring in this habitat type include western meadowrue, sweet-cicely, false Solomon's-seal, and *Arnica* species.

3.5.2 Douglas fir Series

3.5.2.1 Douglas fir/ Pinegrass (*Pseudotsuga menziesii*/ *Calamagrostis rubescens*) Habitat Type.

Douglas fir/ pinegrass was a dominant habitat type at German Gulch and represented 23.6% of the plots sampled. This habitat type occurred on moderately dry mountainsides and upper slopes between 6,000 feet and 7,000 feet on north and east aspects. Pfister notes this as the highest extension of the Douglas fir series (Pfister, Kovalchik et al. 1977).

The dominant seral tree species observed was lodgepole pine. This habitat type has a diverse shrub understory including spiraea, oregongrape, common juniper, common snowberry, common chokecherry, and serviceberry. The grass component noted in the habitat type includes pinegrass, elk sedge, bluebunch wheatgrass, Idaho fescue, and rough fescue. Heart-leaved arnica, pussytoes, showy aster, and wild strawberry are the most abundant forbs listed for this habitat type.

3.5.2.2 Douglas fir/ Elk Sedge (*Pseudotsuga menziesii*/ *Carex geyeri*) Habitat Type. At German Gulch, this habitat type was most commonly observed on moderately steep to very steep slopes at elevations of 6,000 - 7,000 feet. There was a tendency to find this on eastern and southern aspects. The Douglas fir/ elk sedge habitat type occurs on drier sites than the previously discussed Douglas fir/ pinegrass habitat type (Pfister, Kovalchik et al. 1977).

Douglas fir is generally the only tree species found within this habitat type. Common shrub species occurring are common juniper, spirea, common snowberry, serviceberry, ninebark, and Oregon grape. Grass species associated with this habitat type are elk sedge, pinegrass, bluebunch

wheatgrass, Idaho fescue, and rough fescue. Dominant forbs are sweet-cicely, western meadowrue, and false Solomon's-seal.

3.5.2.3 Douglas fir/ Bluebunch Wheatgrass (*Pseudotsuga menziesii*/ *Agropyron spicatum*) Habitat Type. Pfister notes this as the warm-dry extreme of the Douglas fir series occurring at lower elevations with full southern exposure. At German Gulch this habitat type was located between 5,500 feet and 6,500 feet in elevation on steep southern slopes. This is consistent with Pfister's description.

Other tree species that commonly occur within this habitat type are Rocky Mountain juniper, limber pine, and lodgepole pine. Shrub species common to this habitat type are big sagebrush, russet buffaloberry, bitterbrush, spiraea, Oregon grape, common juniper, common snowberry, common chokecherry, and serviceberry. Vegetation is sparse on this habitat type with bluebunch wheatgrass and arrow-leaved balsamroot occurring as dominant undergrowth species. Idaho fescue can be a common part of this habitat type west of the Continental Divide (Pfister, Kovalchik et al. 1977).

Pfister notes that there is high competition with grasses within this habitat type and that natural regeneration on clearcut sites can take 20-40 years.

3.5.2.4 Douglas fir/ Snowberry (*Pseudotsuga menziesii*/ *Symphoricarpos albus*) Habitat Type. This habitat type occurred only once within the sample sites. The site was on a lower slope along an eastern aspect between 5,500 feet and 6,000 feet in elevation. Pfister suggests that this habitat type can occur at much higher elevations although no other stands were located at German Gulch. Pfister notes its common occurrence on warm benches and lower slopes (Pfister, Kovalchik et al. 1977).

This habitat type is similar to the bunchgrass habitat types of this series and reflects a transitional environment between moister habitat types. The shrub and grass components are very similar to that of the Douglas fir/ bluebunch wheatgrass community types. Dominant seral tree species are Rocky Mountain juniper and limber pine. Shrub species occurring are russet buffaloberry,

ninebark, spirea, Oregon grape, common snowberry, common chokecherry, and serviceberry. Of interest, bitterbrush is represented in certain phases of this habitat type and may be present at German Gulch. Grass species associated with this habitat type are elk sedge, pinegrass, bluebunch wheatgrass, Idaho fescue, and rough fescue. Dominant forbs are heart-leaved arnica, arrow-leaved balsamroot, and false Solomon's-seal

3.5.2.5 Douglas fir/ Dwarf Huckleberry (*Pseudotsuga menziesii*/ *Vaccinium caespitosum*) Habitat Type. This habitat type was observed at only one location on an east aspect at 6,500 - 7,000 feet in elevation and is the wettest habitat type of the Douglas fir series observed at German Gulch. In accordance with Pfister, this habitat type occurred on warm, moist well-drained benches and gentle slopes (Pfister, Kovalchik et al. 1977). Typical old growth stands are open and park-like suggesting frequent ground fires (Pfister, Kovalchik et al. 1977). Very little rock or bare soil is exposed on these sites.

Lodgepole pine can be a seral tree species in Douglas fir dominated stands. Undergrowth is dominated by pinegrass, elk sedge, dwarf huckleberry, and bearberry. Common snowberry may also be present.

3.5.3 Lodgepole Pine Series

3.5.3.1 Lodgepole Pine/ Grouse Whortleberry (*Pinus contorta*/ *Vaccinium scoparium*) Habitat Type. The lodgepole pine/ grouse whortleberry habitat type occurred at 8.1% of the sites sampled. Pfister notes this habitat type as occurring on relatively cold, dry sites on gentle slopes and ridge tops near the Continental Divide (Pfister, Kovalchik et al. 1977). At German Gulch, these communities were located between 7,000 feet and 7,500 feet in elevation along north and eastern aspects.

As with the previous habitat type, lodgepole pine is the dominant, and generally the only, tree species. Conspicuous understory species found in this habitat type are grouse whortleberry, pinegrass, bearberry, elk sedge, and heart-leaved arnica.

3.5.3.2 Lodgepole Pine/ Twinflower (*Pinus contorta/ Linnaea borealis*) Habitat Type. The lodgepole pine/ twinflower habitat type is restricted to northern and eastern exposures on moderately steep slopes between 6,000 feet and 7,000 feet in elevation. Pfister lists sites as benchlands and north facing mid-slopes (Pfister, Kovalchik et al. 1977). A well-developed duff layer with little exposed rock and no bare soil characterized the ground layer with soils of non-calcareous origin.

Lodgepole pine is the dominant, and generally the only, tree species found in this habitat type. Undergrowth is dominated by twinflower, globe huckleberry, grouse whortleberry, and pinegrass. Other shrubs of interest are russet buffaloberry, spirea, and common juniper.

3.5.3.3 Lodgepole Pine/ Pinegrass (*Pinus contorta/ Calamagrostis rubescens*) Habitat Type. The lodgepole pine/ pinegrass habitat type was observed at only one location on an east facing mid-slope between 7,000 feet and 7,500 feet in elevation on a western exposure. A well-developed duff layer with little exposed rock and no bare soil characterized the ground layer with soils of non-calcareous origin.

Lodgepole pine is the dominant and generally the only tree species found in this habitat type. Pfister notes that this is the only tree species that may be successfully replanted in this habitat type (Pfister, Kovalchik et al. 1977). Undergrowth is dominated by pinegrass, elk sedge, spirea, heart-leaved amica, and bearberry.

3.5.4 Grassland Series

3.5.4.1 Idaho Fescue/ Bluebunch Wheatgrass (*Festuca idahoensis/ Agropyron spicatum*) Habitat Type. Mueggler lists this habitat type as the most frequently encountered mountain grassland habitat type in southwestern Montana (Mueggler and Stewart 1980). In general, it occurred from 6,000 - 7,500 feet in elevation along from rolling terrain to moderately steep mountainsides. This habitat type strongly tended towards the drier south and west aspects.

The dominant forage species within this habitat type are Idaho fescue and bluebunch wheatgrass with prairie junegrass occasionally present. The most abundant forbs generally present are yarrow, Hood's phlox, chickweed, silky lupine, prairiesmoke and rose pussytoes.

3.5.4.2 Rough Fescue/ Idaho Fescue (*Festuca scabrella*/ *Festuca idahoensis*) Habitat Type.

In contrast to the Idaho fescue/ bluebunch wheatgrass habitat type, this habitat type occurs on moister, gentler sloped areas (Mueggler and Stewart 1980). Indeed, sampling data indicate that this habitat type occurred strictly on rolling terrain (slopes < 35%) within the 5,500 - 6,000 feet elevation range on west aspects. Mueggler notes that it may be found on any aspect.

Dominant species within these habitat types are western needlegrass, prairiesmoke, northern bedstraw, common harebell, prairie junegrass, silky lupine, wild geranium, and graceful cinquefoil.

3.5.4.3 Rough Fescue/ Bluebunch Wheatgrass (*Festuca scabrella*/ *Agropyron spicatum*) Habitat Type.

This habitat type was found exclusively on western slopes between elevations of 5,500 feet and 6,500 feet in elevation at German Gulch. Mueggler describes this as a moderately arid habitat type occurring on level topography to steep slopes (Mueggler and Stewart 1980).

This habitat type provides a moderate amount of ground cover consisting mainly of rough fescue, bluebunch wheatgrass, and Idaho fescue. Some common forbs are arrow-leaved balsamroot, Wyoming kitten-tails, indian paintbrush, desert parsley, and silky lupine.

3.5.5 Shrub Series

3.5.5.1 Bitterbrush/ Bluebunch Wheatgrass (*Purshia tridentata*/ *Agropyron spicatum*) Habitat Type.

The bitterbrush/ bluebunch wheatgrass habitat type was observed only once during sampling although variations with a fescue component were observed at various elevations throughout the study area. The site was a dry south-facing slope located at low elevation. Mueggler notes that this habitat type is generally located as small patches in specialized environments (Mueggler and Stewart 1980). Soils for this habitat type are generally described as

dry, shallow, and rocky with considerable bare soil and rock exposed at the surface (Mueggler & Stewart 1980).

The shrub community of this habitat type is dominated by open stands of bitterbrush with minor amounts of rubber rabbitbrush and green rabbitbrush. The dominant grass is bluebunch wheatgrass with minor amounts of prairie junegrass, Sandberg bluegrass, and needle-and-thread grass. Common forbs are arrow-leaved balsamroot, golden aster, silky lupine, yellow puccoon, yellow salsify, and yarrow.

3.6 Spatial Analysis of Survey Data and Habitat Modeling

The process previously described for the selection of survey locations, including the survey methods employed at each location, was designed to identify existing habitat types and the site factors that determine their distribution across the landscape at the German Gulch RA. The process of habitat modeling using GIS software was employed to describe the relationships between site factors and habitat types, and to quantify the occurrence of these same relationships at the Stucky Ridge and Smelter Hill IA. The result of this modeling is an understanding of the vegetation communities that would likely have been found at the Stucky Ridge and Smelter Hill IA given the absence of historic disturbances, and a description of potential vegetation communities to be restored.

3.6.1 Spatial Analysis Methods

Two sets of habitat models were prepared using ArcView GIS software (ESRI 2000). The first, a “descriptive model” of the occurrence of habitat types at German Gulch, incorporated observational data collected at each survey location and the site factors (slope, aspect, elevation) characteristic of each location. The product of this descriptive model is a map that displays the assumed distribution of habitat types throughout the German Gulch RA based upon the observations made at the 73 survey locations. The second set, “predictive models” of the potential habitat types at the Stucky Ridge and Smelter Hill IA, is essentially identical to the first model, incorporating the same criteria (site factor combinations and resultant habitat types) to describe the site potential in terms of vegetation. The products of these predictive models are maps that display the predicted distribution of habitat types throughout the Stucky Ridge and

Smelter Hill IA based upon the landform characteristics found there and analysis of observations made during the RA surveys.

The basic modeling process utilizes GIS technology (in this case, ArcView 3.2 with the Spatial Analyst 2 extension) to describe and analyze the project site using various geographically referenced map layers (site topography, location of features, etc.). These map layers can be classified, queried individually, or overlaid in combination to provide locational information about features or to create new map layers representing selected attributes or data. For the purposes of this project, map layers were produced representing elevation range, aspect, and percent slope of the entire project area. The analysis of field survey data (described in **Section 3.3**) provided criteria for the classification of these map layers and the combination of these data to determine the occurrence of habitat types at the RA and, subsequently, the IA.

The habitat typing manuals utilized during the German Gulch RA field surveys (specifically Pfister, Kovalchik et al. 1977) describe the occurrence of various habitat types within elevation ranges of 500-foot intervals. For this reason, the elevation map created for the model was classified similarly, 6,000 - 6,500 feet, 6,500 - 7,000 feet, etc. Analysis of the field data also indicated that aspect strongly determined the occurrence of habitat types, so a map layer was created which classified site topography based upon the four cardinal directions (north, south, east, and west) plus flat. Some of this mapped data (such as slope) would enter the spatial analysis later during the prescription phase.

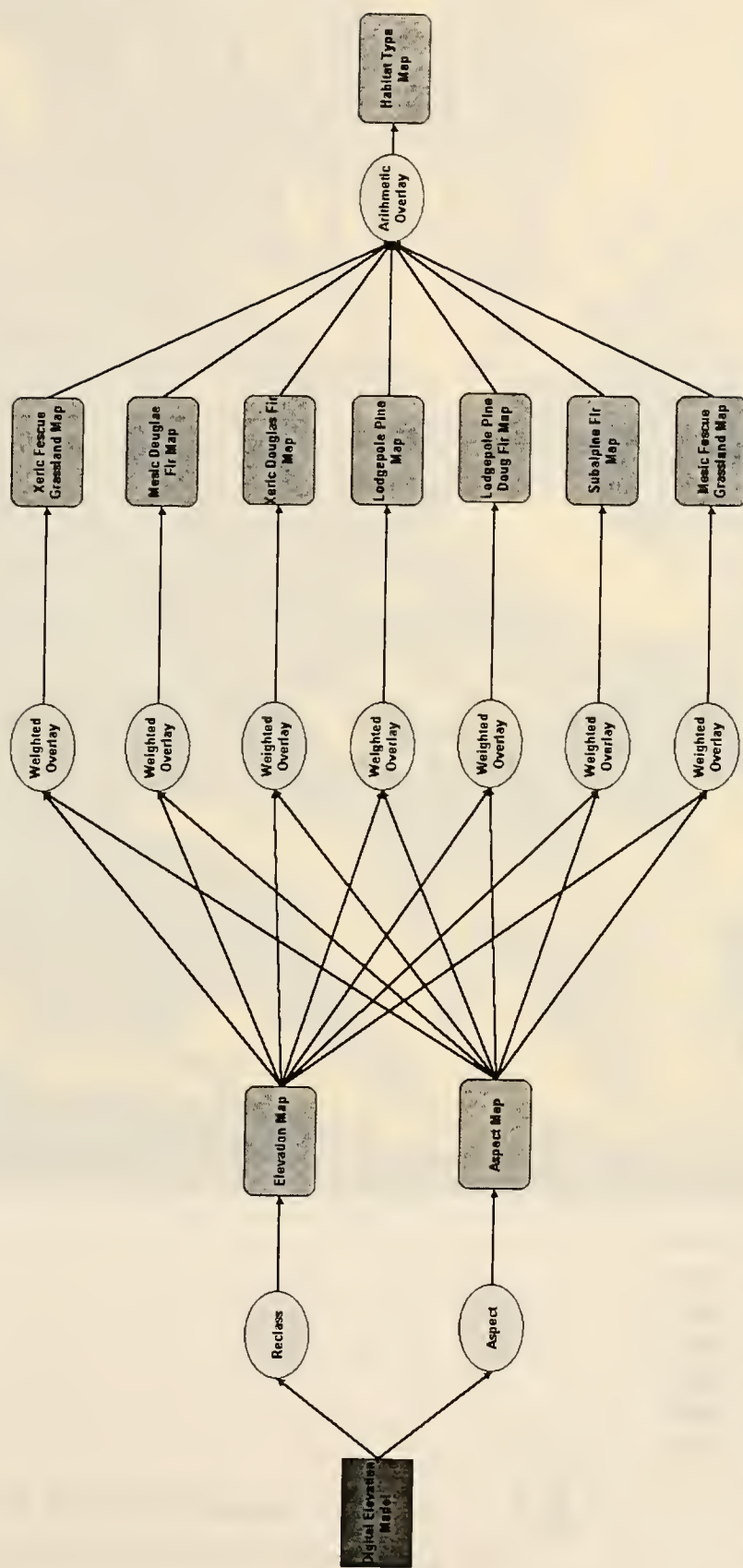
A spatial analysis was performed that incorporated the parameters for habitat type occurrence (as presented in **Table 3.6.1.1** and described in **Section 3.3**) as unique combinations of both elevation and aspect. This process is illustrated by **Figure 3.6.1.1**. Basically, the Elevation and Aspect Map layers were combined using a “weighted overlay” process which assigns unique numerical values to each elevation class (ex. 6,000’-6,500’ =1, 6,500’-7,000’ =2, etc.) and to each aspect class (north =3, south =5, etc.). The map layers are then overlaid and overlapping numeric values are tallied to produce unique values that represent the various combinations of the classes (ex. 6,000’ - 6,500’ + North =4, 6,500’ - 7,000’ + South =7). The map layers resulting from this process represent the occurrence of a habitat type (ex. 6,000’-6,500’ + North = 4 =Douglas Fir

Habitat) across the site. Predicted habitat types for German Gulch are presented in **Figure 3.6.1.2.**

Table 3.6.1.1. Model parameters based upon observed elevation and aspect of series.

Dominant Series	Elevation (feet)	Aspect
Xeric Douglas fir	5000-5500	N
Xeric fescue grassland	5000-5500	S
Xeric fescue grassland	5000-5500	E
Xeric fescue grassland	5000-5500	W
Xeric fescue grassland	5000-5500	Flat
Mesic Douglas fir (no data)	5500-6000	N
Xeric Douglas fir	5500-6000	E
Xeric Fescue Grassland	5500-6000	S
Xeric Fescue Grassland	5500-6000	W
Xeric Fescue Grassland	5500-6000	Flat
Mesic Douglas fir	6000-6500	N
Mesic Douglas fir	6000-6500	E
Xeric Fescue Grassland	6000-6500	S
Xeric Fescue Grassland	6000-6500	W
Xeric Fescue Grassland	6000-6500	Flat
Lodgepole pine & Douglas fir	6500-7000	N
Lodgepole pine & Douglas fir	6500-7000	E
Mesic Fescue Grassland	6500-7000	S
Xeric Douglas fir	6500-7000	W
Xeric Douglas fir	6500-7000	Flat
Subalpine fir	7000-7500	N
Lodgepole pine	7000-7500	E
Mesic Fescue Grassland	7000-7500	S
Subalpine fir	7000-7500	W
Subalpine fir	7000-7500	Flat

Figure 3.6.1.1. Spatial Analysis Model.



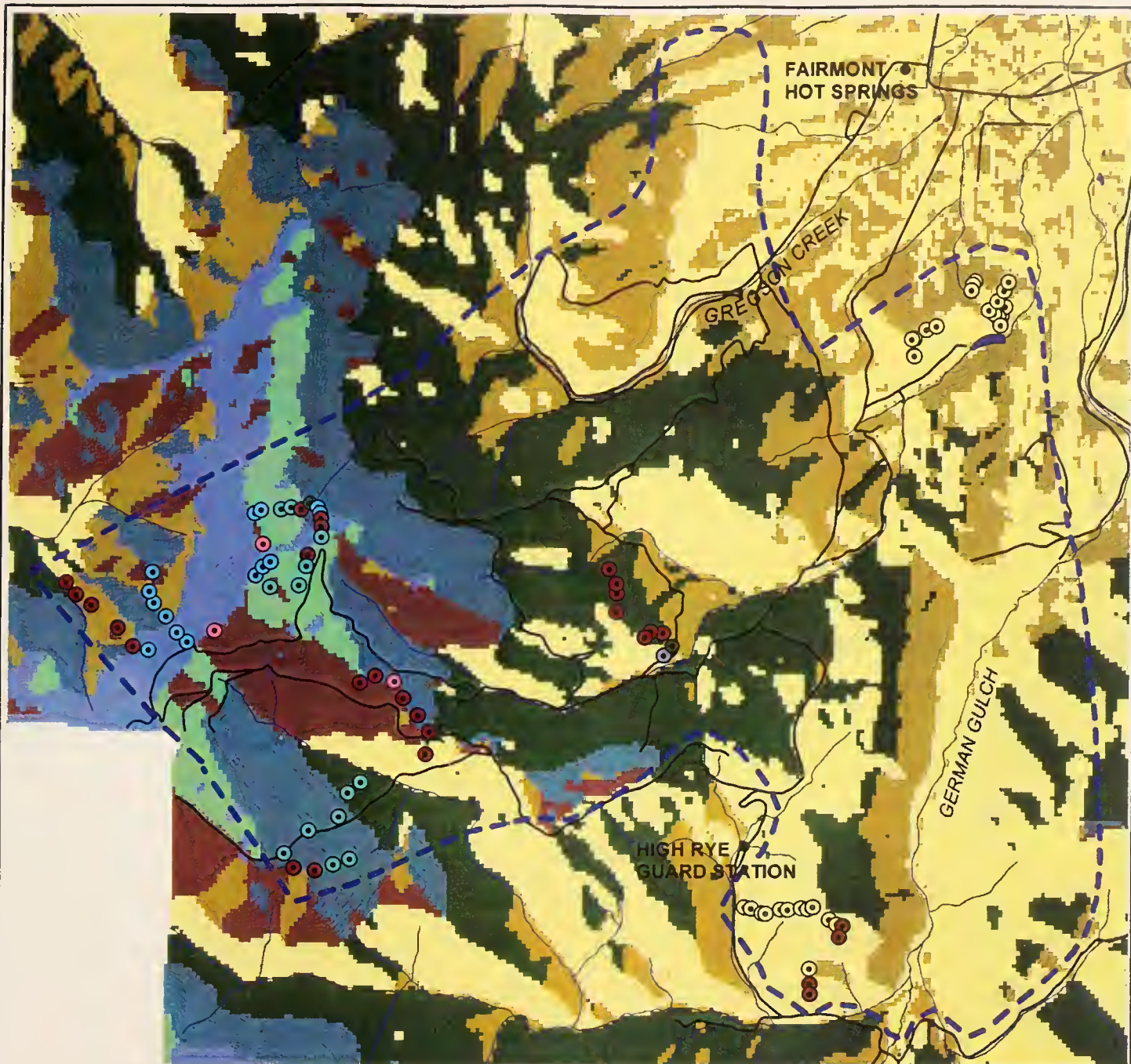


FIGURE 3.6.1.2

German Gulch Habitat Model

Field investigations conducted Summer, 2000 and 2001 by BRI



0 3000 6000 9000 Feet



Predicted Habitat Classes

- Douglas Fir (Xeric) Habitat
- Douglas Fir (Mesic) Habitat
- Subalpine Fir Habitat
- Lodgepole Pine Habitat
- Lodgepole Pine/Douglas Fir Habitat
- Fescue Grassland (Mesic) Habitat
- Fescue Grassland (Xeric) Habitat

- Streams and Creeks
- Roads
- Topographic Contours (50 ft.)
- Lakes and Reservoirs
- German Gulch Reference Area (BRI, 2001)

The individual Habitat Type maps were then combined to create an overall map of habitats across the site. This combination employs an “arithmetic overlay” process that assigns another unique numeric value to each habitat type. These map layers are then overlaid and the numeric values tallied (in this case, values do not overlap) with the result being a map that displays all of the habitat types on a single map layer. This Habitat Map layer could then be queried to provide information related to the distribution of vegetation types across the site (such as acreage of each habitat type).

3.6.2 Spatial Analysis Results

The results of habitat modeling at the Stucky Ridge and Smelter Hill IA are displayed on maps (**Figures 3.6.2.1 and 3.6.2.2**) portraying the predicted distribution of vegetation communities (series) across the sites (**Table 3.6.2.1**). This distribution represents the likely occurrence of vegetation communities at the site given the absence of historic disturbances. These results indicate that approximately 65% of the Stucky Ridge IA would have supported intermountain grassland and shrub communities, with the remaining 35% of the site supporting forest stands, primarily of Douglas fir habitat types. Approximately 35% of the Smelter Hill IA would have supported intermountain grassland and shrub communities, and 65% would have supported forest stands, primarily of Douglas fir habitat types.

Among these forest community types, xeric Douglas fir forests would have occurred across approximately 27% of the project area, inhabiting north aspects below 5,500 feet, east aspects in the 5,500 - 6,000 elevation range, and west aspects at higher elevations (6,500 - 7,000 feet). Another 17% of the site would have supported mesic Douglas fir forests on north aspects in the 5,500 - 6,000 feet elevation range, and north and east aspects between 6,000 feet and 6,500 feet. The predominant vegetation community, predicted to cover approximately 42% of the IA, is xeric fescue grassland. In an undisturbed setting, this vegetation series would occupy south and west-facing slopes between 5,000 - 6,500 feet, as well as east-facing slopes between 5,000 - 5,500 feet.

Table 3.6.2.1. Acreage of predicted vegetation series at Stucky Ridge & Smelter Hill Injured Areas.

Series	Predicted Acreage Stucky Ridge	Predicted Acreage Smelter Hill	Total Acreage
fescue grassland (xeric)	1514	1466	2980 (44% of total)
fescue grassland (mesic)	0	187	187 (3% of total)
subalpine fir	0	38	38 (0.6% of total)
lodgepole pine/ Douglas fir	0	169	169 (2% of total)
lodgepole pine	0	13	13 (0.2% of total)
Douglas fir (xeric)	726	1237	1963 (29% of total)
Douglas fir (mesic)	112	1353	1465 (22% of total)
Total acreage	2352	4463	6815

Figure 3.6.2.3 and **Figure 3.6.2.4** illustrate existing locations of aspen stands as well as the predicted proportions of forest, shrub, and grassland habitat types of the Anaconda Uplands IA under remedy and restoration treatment prescriptions. Both the species composition and the spatial configuration of forested, shrub, and grassland habitats vary dramatically. Differences in the predicted distribution of vegetation, as well as in the composition of habitat types are caused by dissimilar approaches to revegetation.

BRI's restoration treatment prescriptions were developed using an ecological approach to restoration. A spatial analysis of undisturbed habitats in the vicinity of the IA indicated that the locations of vegetation communities were dependent on elevation and aspect. Thus, the boundary between grasslands and forest lands was delineated based upon breaks in elevation and aspect.

ARCO's remedy treatment approach, in contrast, was based on the condition of existing vegetation and the slope of the terrain. If the amount of existing vegetation in a given area met remedy requirements, it was assumed that the site would continue to recover naturally regardless of the historical character of the vegetation. On poorly vegetated sites, the slope of the unit determined the reclamation prescription. Grasslands were assigned to flat or gentle slopes where

mechanized equipment can access the area. Shrubs and trees were assigned to steep slopes that are inaccessible to mechanized equipment. Although ARCO's reclamation plan calls for the use of native plant species, it does not emphasize plant diversity nor the reestablishment of native plant communities that mimic undisturbed settings. The resulting plant communities are simplified and emphasize erosion control.

BRI proposes to restore a mosaic of forested and grassland habitats to Stucky Ridge-North based upon elevation and aspect characteristics (**Figure 3.6.2.3**). Under BRI's restoration treatments, the northern section of the IA would be forested, consisting primarily of the xeric Douglas fir habitat association. This area lies on a north-facing slope between 5,000 feet and 6,000 feet in elevation. Xeric grassland communities would occupy the remainder of the site. Based on ARCO's remedy treatment plan, steep hillsides throughout the IA would be planted with trees and shrubs, while flat to gently sloped hillsides would consist of grass species (AERL 2001b). Areas that are determined to be naturally recovering, i.e.—aspen stands, would not receive active treatment.

BRI proposes to restore the southern portion of Stucky Ridge with grassland habitats due to the predominance of south and west-facing slopes and elevations below 6,500 feet. Forest species would be interspersed on north and east-facing aspects throughout the northern part of the IA. Aspen stands are considered important wildlife habitat and will not be disturbed. ARCO, in contrast, proposes to promote tree and shrub growth within existing riparian corridors and on steep slopes in the southern section of Stucky Ridge (AERL 2002; AERL 2001d,e,f,g). Grasses would dominate the gently sloped mid-section of the IA. ARCO's plan incorporates fewer native plant species, resulting in simplified habitats. In addition, the distribution of plants does not necessarily mimic their natural occurrence.

BRI proposes to restore forest habitats on 52% and grassland habitats on 32% of Smelter Hill while the remaining 16% will consist of existing aspen stands. Aspen stands are considered important wildlife habitat and will not be disturbed. Under ARCO's plan, 8% of the IA would be on a trajectory toward conifer forest communities, 16% to aspen stands, 31% planted to woody erosion control plantings, and 45% would become grasslands (**Figure 3.6.2.4**). BRI recommends

replanting the eastern portion of the IA with forest species. Aspects in this area are north and east-facing and elevations range from 5,500 - 7,000 feet. In the same location, ARCO is promoting grassland communities due to the gentle slopes of the terrain and the perceived recovery of vegetation (AERL 2001h,i,j).

The southwest portion of Smelter Hill is also treated differently under the two plans. While BRI recommends restoring the area to forest habitats, the ARCO plan promotes grassland establishment. Once again, the species selection under BRI's restoration plan consists of a diverse array of native species planted in ecologically appropriate habitats. In contrast, ARCO's plan incorporates small numbers of native plant species, resulting in simplified habitats. In addition, the distribution of plants does not necessarily mimic their natural occurrence.

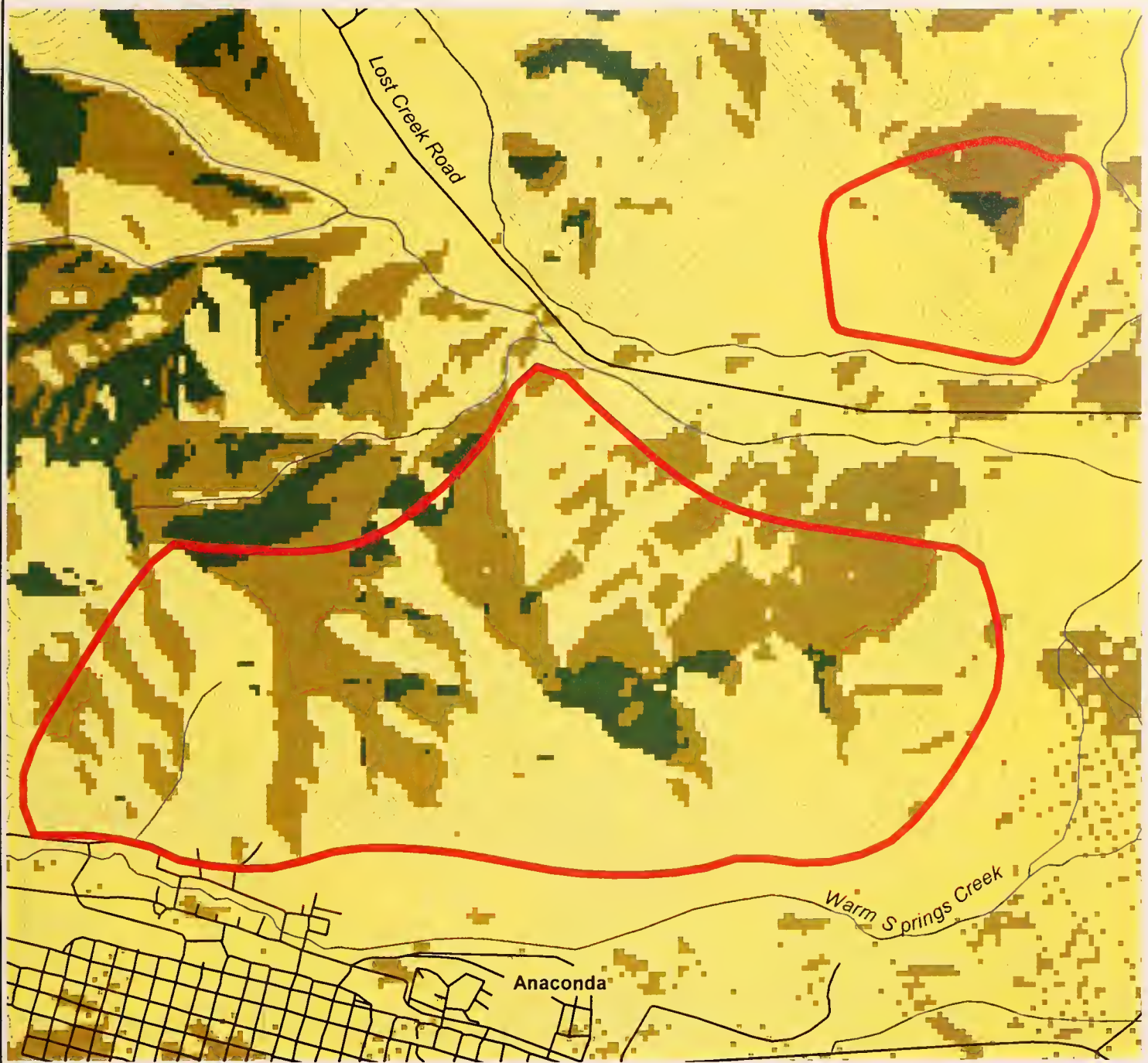


FIGURE 3.6.2.1

Stucky Ridge Habitat Model

Based on field investigations of the German Gulch Reference Area conducted Summer, 2000 and 2001 by BRI



0 2000 4000 6000 Feet



Predicted Habitat Classes

- Douglas Fir (Xeric) Habitat
- Douglas Fir (Mesic) Habitat
- Fescue Grassland (Xeric) Habitat

- Streams and Creeks
- Roads
- Topographic Contours (50 ft.)
- Stucky Ridge Injured Area Boundary

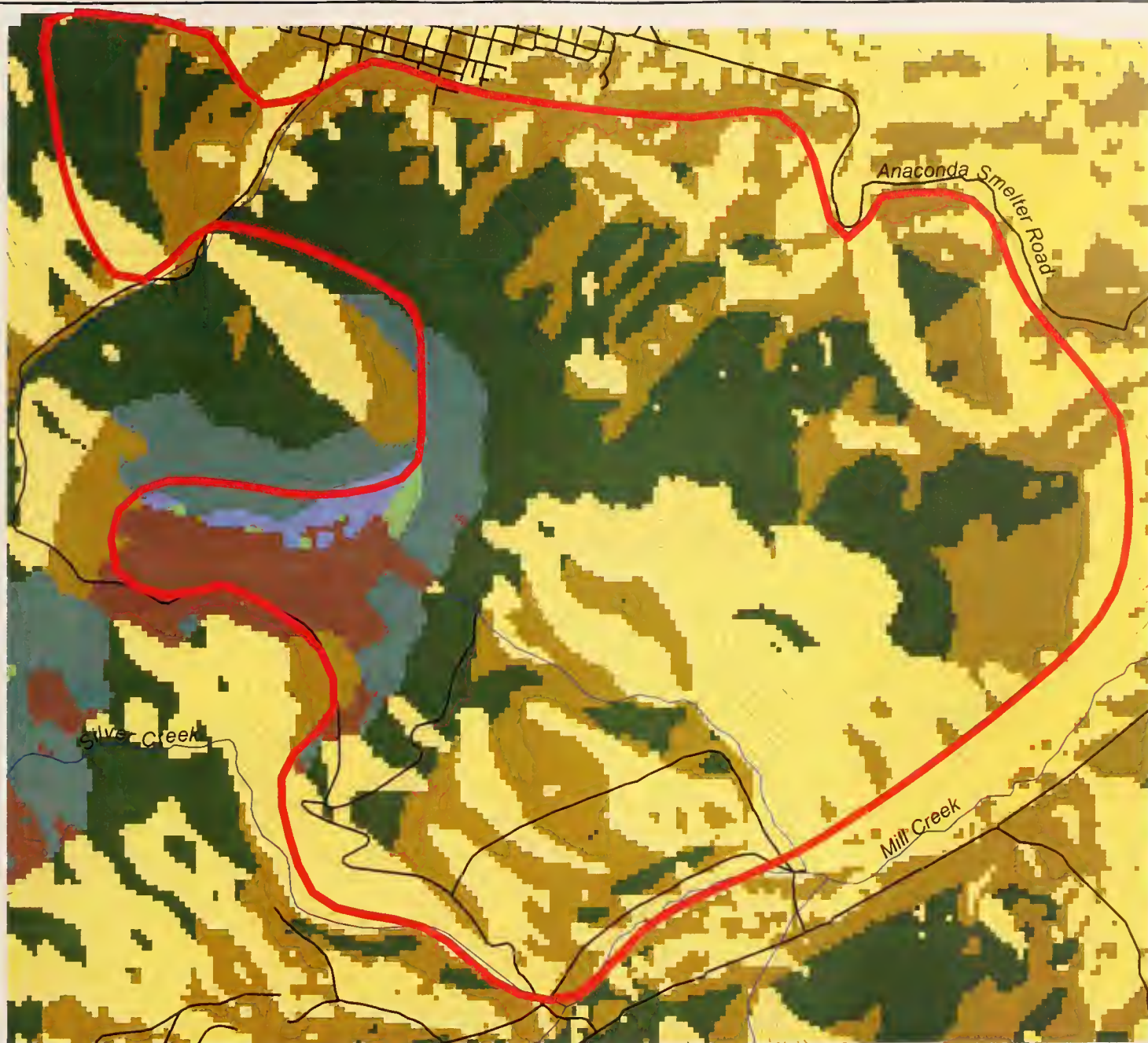


FIGURE 3.6.2.2

Smelter Hill Habitat Model

Based on field investigations of the German Gulch Reference Area conducted Summer, 2000 and 2001 by BRI



0 2000 4000 6000 Feet



Predicted Habitat Classes

- Douglas Fir (Xeric) Habitat
- Douglas Fir (Mesic) Habitat
- Subalpine Fir Habitat
- Lodgepole Pine Habitat
- Lodgepole Pine/Douglas Fir Habitat
- Fescue Grassland (Mesic) Habitat
- Fescue Grassland (Xeric) Habitat
- Streams and Creeks
- Roads
- Topographic Contours (50 ft.)
- Smelter Hill Injured Area Boundary

Predicted Restoration Vegetation

2% Existing Aspen
35% Forest
63% Grassland



Predicted Remedy Vegetation

11% Existing Aspen/
Conifer Forest
24% Woody Plant Reclamation
65% Grassland

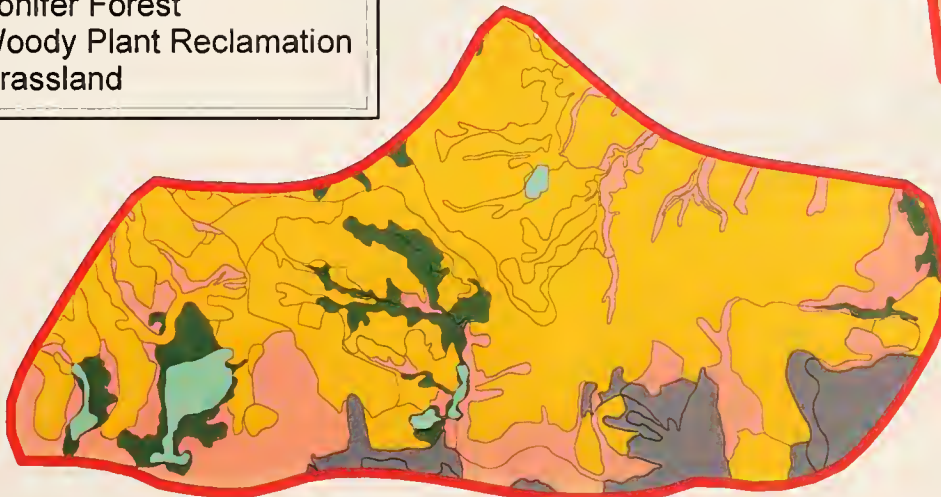


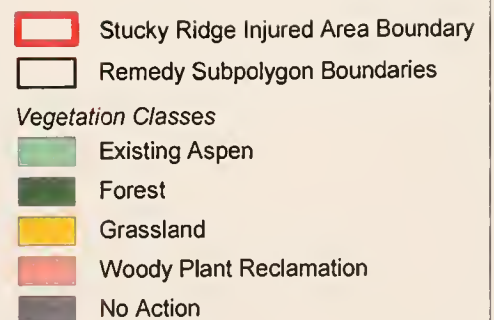
FIGURE 3.6.2.3

Predicted Restoration Vegetation & Remedy Vegetation for Stucky Ridge

Based on spatial modeling conducted by BRI (top map) and the Uplands Area Remedial Design by ARCO Environmental Remediation (bottom map)



0 3000 6000 Feet

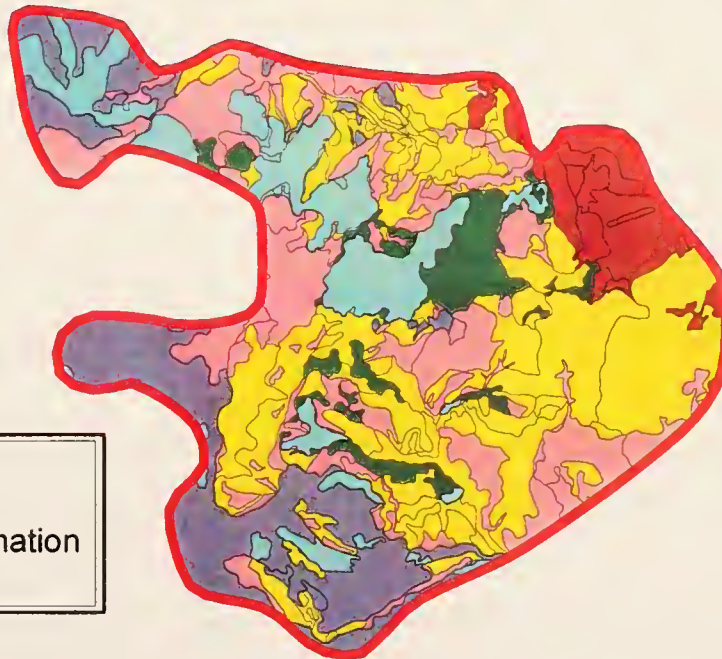


Predicted Restoration Vegetation



16% Existing Aspen
52% Forest
32% Grassland

Predicted Remedy Vegetation



16% Existing Aspen
8% Forest
31% Woody Plant Reclamation
45% Grassland

FIGURE 3.6.2.4

Predicted Restoration Vegetation & Remedy Vegetation for Smelter Hill

Based on spatial modeling conducted by BRI (top map) and the Uplands Area Remedial Design by ARCO Environmental Remediation (bottom map)



0 4000 8000 Feet



- Smelter Hill Injured Area Boundary
- Remedy Subpolygon Boundaries
- Vegetation Classes**
- Existing Aspen
- Forest
- Grassland
- Woody Plant Reclamation
- No Action
- Disturbed Land

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SECTION 4

CHARACTERIZATION OF THE STUCKY RIDGE AND SMELTER HILL INJURED AREA

Section 4: Characterization of Stucky Ridge and Smelter Hill IA

The IA was investigated to assess the extent and character of environmental damage at the site. The purpose of this exercise is to identify existing conditions on site and provide supportive evidence for the use of specified site restoration techniques.

4.1 Background

During the spring and summer of 2001, BRI employees selected and inventoried 86 polygons in the IA. The sample set of inventoried polygons was selected using the following methods:

- Non-ARCO owned polygons for each IA were divided into sets representing the following remedial approaches proposed by ARCO and then ordered by acreage:
 - Till to Twelve Inches (T12)
 - Till to Six Inches (T6)
 - Vegetation Improvement (VI)
 - Steep Slope Reclamation (SSR)
 - Monitored Well Vegetated (MWV)
 - Well Vegetated (WV)
 - Previously Reclaimed (PR)
 - No Action Rock (NAR)
 - No Action (NA)
- Polygons from each set of treatment remedies were then picked, from largest to smallest size, until the following criteria had been met:
 - At least 40% of the number of polygons for each treatment remedy were chosen, and;
 - At least 60% of the acreage for each treatment remedy was covered.

These methods identified 38 remediation polygons on Smelter Hill for inventory. As shown in **Table 4.1.1**, these polygons represent 51% of all polygons designated for remediation on Smelter Hill, as well as 89% of the total remedial acres in the Smelter Hill IA. To investigate existing

conditions on sites in the IA for which no remedial action had been developed, BRI also sampled 5 additional polygons on Smelter Hill.

Table 4.1.1. Smelter Hill: polygon inventory summary.

Remedial Action	Total Polygon Count	Inventoried Polygon Count	% Polygons Inventoried	Total Polygon Acres ¹	Inventoried Acres ¹	% Acres ¹ Inventoried
MWV	21	9	43%	743	682	92%
NA-F	2	2	100%	10	10	100%
PR	1	1	100%	14	14	100%
SSR	35	14	40%	579	485	84%
T12	3	3	100%	82	82	100%
T6	3	3	100%	15	15	100%
VI	6	3	50%	82	53	65%
WV	4	3	75%	111	107	96%
TOTAL	75	38	51%	1636	1448	89%
NA	5	5	100%			

¹Acres represent areas to which BRI had access; BRI did not inventory ARCO-owned polygons

43 polygons were also identified for inventory on Stucky Ridge and Stucky Ridge North, which shall be referred to cumulatively as Stucky Ridge area in this report. As shown in Table 4.1.2, these 43 polygons represent 43% of all polygons designated for remediation on Stucky Ridge, as well as 87% of the total remedial acres of the Stucky Ridge IA.

Table 4.1.2. Stucky Ridge: polygon inventory summary.

Remedial Action	Total Polygon Count	Inventoried Polygon Count	% Polygons Inventoried	Total Polygon Acres ¹	Inventoried Acres ¹	% Acres ¹ Inventoried ¹
MWV	11	4	36%	105	87	83%
NA-R	5	2	40%	92	73	79%
PR	5	2	40%	123	84	68%
SSR	36	14	39%	498	438	88%
T12	6	3	50%	328	315	96%
T6	9	5	56%	251	239	95%
VI	8	4	50%	105	87	83%
WV	21	9	43%	274	227	83%
TOTAL	101	43	43%	1776	1550	87%

¹Acres represent areas to which BRI had access; BRI did not inventory ARCO-owned polygons.

4.2 Field Sampling

The following protocols were utilized during field sampling to characterize existing environmental conditions in the polygons of Stucky Ridge and Smelter Hill.

- Transects for field examination hand drawn on site maps to address the following criteria:
 - To intersect the point at which ARCO contractors collected soil samples;
 - To maximize the absolute length of the transect,
 - To maximize the elevation gain across the length of the transect, and
 - To minimize the interfingering of other polygons across the transect line.
- This information was then translated to a GIS map layer and loaded into GPS units. **Figure 4.2.1** and **Figure 4.2.2** denote the transect locations, respectively, on Stucky Ridge and Smelter Hill.
- In the field, one end of each polygon's transect was first found using the GPS units.
- The field investigator then walked the transect line denoted on the GPS units. The field investigator was not limited to walking the transect line, but used it as a guide to ensure full coverage of the entire polygon.
- While walking the polygon, the field investigator developed a list of plant species observed across the entire polygon.
- The field investigator also listed erosion features on each polygon, using on the following definitions:
 - Sheet erosion – uniform soil detachment resulting in a general downslope movement of soil particles. Evidenced by pedestaled plants and other indications of a uniform reduction of soil level.
 - Rill erosion – evidenced by visible channels where water can concentrate. Channels are small enough to remove by normal tilling or grading operations.
 - Gully erosion – intermittent stream channels too large to repair using normal tilling or grading methods.
 - Wind erosion – evidenced by scour marks on existing woody debris, or wave-like soil distribution patterns.

- Slump or mass wasting – evidenced by fracture lines parallel to slope contour or large soil deposits near the base of slope.
- Microsite features within 30 feet by 6 feet swaths were counted at the beginning of the transect, at the first quarter point, at the midpoint, at the third quarter point, and at the end of the transect.
- During the inventory, unusual features such as building foundations or comments about the plantability of the polygon's soils were also recorded.
- At the midpoint of each transect, the field investigator stopped and took pictures from the center towards the direction of the transect's start point and endpoint. Where transects were interrupted by interfingering of other polygons (e.g. there were two distinct legs to the transect line), photos were taken at the center point of each transect's leg.
- At the endpoint of the polygon, the field investigator recorded his ocular estimate of the following characteristics:
 - Canopy cover of individual species
 - Erosional features and percent of polygon affected by major erosion type
 - Browse intensity
 - Microsite density
 - Dominant ground cover as defined by the following classes:
 - Bare soil (< 1/16 diameter soil particles)
 - Gravel (1/16 – 3 inch diameter gravel)
 - Rock (> 3 inches diameter)
 - Litter (freshly fallen leaves, needles, twigs, bark, fruits) and duff (fermentation and humus sections of organic layer)
 - Downed wood greater than ¼ inch diameter
 - Basal vegetation is the soil covered by the basal or root crown portion of the plant
- The field investigator also recorded a general description of the polygon, with comments about the site conditions, challenges to and opportunities for restoration.
- In some cases, different researchers walked different legs of the same polygon. In these instances, the results from the different legs were composited to provide a single overview of each polygon's environmental characteristics.

- Across the course of the field study, the following issues impacted the set of polygons that were sampled.
- Originally, polygons sets were separately selected for Stucky Ridge and Stucky Ridge North. The polygons from these two areas were later combined for analysis, yielding a set of sampled polygons that would not match a combined set of polygons absolutely ordered by acreage. Nonetheless, the sampled polygons account for 87% of the polygon surface areas designated for remedial action on the two Stucky Ridge areas.
 - Fifteen of 36 SSR polygons (42%) were selected for inventory on the Stucky Ridge areas. Due to a deviation from the work plan, only 14 (39%) of these types of polygons were inventoried. The 14 polygons sampled, however, account for 87% of SSR polygon surface areas on the Stucky Ridge area.
 - Five of 11 MWV polygons (45%) were selected for inventory on the Stucky Ridge. Due to a deviation from the work plan, only 4 (36%) of these types of polygons were inventoried. The 4 polygons sampled, however, account for 83% of MWV polygon surface areas on the Stucky Ridge area.

A summary of findings for existing conditions on each of the remedial treatment types inventoried on Smelter Hill and Stucky Ridge are presented individually in the following sections. These sections also include discussions of anticipated future conditions under different treatment scenarios.



FIGURE 4.2.1

Stucky Ridge Field Survey Locations

Field investigations conducted Summer, 2000 & 2001 by BRI



0 2000 4000 Feet



- Remedy Subpolygons Sampled by BRI
- Stucky Ridge Injured Area Boundary
- Streams
- Roads
- Transects

Elevation Model

- 5000' - 5500'
- 5500' - 6000'
- 6000' - 6500'
- 6500' - 7000'

Numbers identify remedy subpolygons with transects.



FIGURE 4.2.2

Smelter Hill Field Survey Locations

Field investigations conducted Summer 2000 & 2001 by BRI



0 2000 4000 Feet



- Remedy Subpolygons Sampled by BRI
- Smelter Hill Injured Area Boundary
- Streams
- Roads
- Transects

Elevation Model

- 5000' - 5500'
- 5500' - 6000'
- 6000' - 6500'
- 6500' - 7000'
- 7000' - 7500'

Numbers identify remedy subpolygons with transects.

4.3 Smelter Hill: Till-Twelve Inches (SH_T12)

BRI personnel inventoried 3 SH_T12 polygons on Smelter Hill, covering 82 of 82 SH_T12 designated, non-ARCO-owned acres on the site. Polygons range in size from 1 acre to 79 acres, with an average size of 27 acres. The elevations of these polygons range from a low of 1650 meters to a high of 1949 meters, with an average elevation of 1750 meters. The average slope is 13%. As shown in **Table 4.3**, most of the polygons' surfaces face South.

Table 4.3. Percentage aspect of polygons, Smelter Hill SH_T12*.

East	West	North	South
11 (19)	12 (22)	0 (0)	76 (21)

*Variables are reported as: percent mean (standard deviation).

4.3.1 Dominant Ground Cover

As shown in **Table 4.3.1**, bare soil, rocks and gravel accounts for seven-eighths of all ground cover on the SH_T12 sites. Together, litter and basal vegetation account for only one-eighth of ground cover on these polygons. The high proportion of gravel and rocks in these areas therefore present a significant challenge to restoration.

Table 4.3.1. Percent ground cover, SH_T12*.

Site Count	Soil	Gravel	Rock	Litter	Basal Veg	Wood	Other
3	40 (20)	17 (12)	30 (17)	7 (11)	8 (4)	1 (2)	0 (0)

*Cover is reported as: mean (standard deviation).

4.3.2 Dominant Vegetation Cover

As shown in **Table 4.3.2.1**, approximately one-fourth of the SH_T12 sites are covered with native plants, while one-tenth is covered with exotic plant species. Both native woody species and forbs meet the standards of restoration for species richness (i.e., five species or more per life form); native grasses do not.

Table 4.3.2.1. Plant cover (percent) and richness (count), SH T12*.

Variable	Forbs	Grasses	Woody	Native	Exotic = Exotic Species + Noxious Weeds	Noxious Weeds
Cover	4 (3)	11 (10)	11 (9)	26 (14)	11 (9)	4 (3)
Richness	6 (3)	3 (2)	7 (3)	16 (6)	4 (2)	2 (1)

*Variables are reported as: mean (standard deviation).

Table 4.3.2.2 shows the three species that both have the greatest cover and that are present on most SH_T12 sites. Quaking aspen (*Populus tremuloides*) has the greatest average canopy cover of all species present (8%), but is present on two of three sites. This is followed by aspen's genetic cousin, black cottonwood (*Populus trichocarpa*), with 5% cover across all three sites. Leafy spurge (*Euphorbia esula*) and redtop (*Agrostis stolonifera*) display comparatively minor cover components, but are also found on all three sites.

Table 4.3.2.2. Dominant plant species, SH T12*.

Species	Percent Cover	Polygon Presence
Quaking aspen	8 (11)	2
Black cottonwood	5 (5)	3
Leafy spurge	2 (1)	3
Redtop	2 (1)	3

*Cover is reported as: mean (standard deviation).

This dominant species list is completely comprised of plants that are adapted both to disturbance and to elevated trace element levels. In addition, leafy spurge covers approximately two acres, spread widely across all SH_T12 sites. This indicates that there is a significant noxious weed infestation problem on the SH_T12 sites.

4.3.3 Erosion Type

As shown in **Table 4.3.3**, all three SH_T12 sites demonstrate significant sheet erosion.

Table 4.3.3. Erosion types and coverage (percent), SH T12*.

	Sheet	TOTAL
Polygon Area Demonstrating Erosion	59 (34)	59 (34)
Count	3	3

*Cover is reported as: mean (standard deviation).

4.3.4 Browse

As shown in **Table 4.3.4**, there is light browse on the two smaller SH_T12 sites, but no browse observed on the larger site.

Table 4.3.4. Browse, SH T12.

None (< 5 percent)	Light (5-25 percent)	Moderate (25-50 percent)	Heavy (>50 percent)
1	2	-	-

4.3.5 Microsite Availability

As shown in **Table 4.3.5**, microsite availability on the SH_T12 polygons range from moderate to inadequate. Together, these data indicate that some areas on these sites, particularly the smaller polygons, significantly lack microsites.

Table 4.3.5. Counts of microsites, SH T12.

Adequate	Moderate	Marginal	Inadequate
-	1	1	1

4.3.6 Current and Future Conditions

As shown in **Table 4.3.6**, none of the expected dominant species are currently present on the SH_T12 sites. The remediation prescription for these sites calls for tilling the soil to 12 inches, applying lime and or organic matter, and drill seeding with an upland herbaceous species mix. Crimped or mulched straw will be applied at a rate of one ton per acre in the transition zones above steep slope reclamation areas. Areas of existing trees and acceptable vegetation will not be disturbed.

Given this remediation scenario and the current absence of expected dominant species, the presence of a dominant species on the SH_T12 sites will be assured only if it is included in the drill seed mix specified for the remedial prescription. Of the eight dominant species expected on the SH_T12 sites, only bluebunch wheatgrass (*Agropyron spicatum*) is included in the remediation drill seed mix.

As a result, future conditions under the proposed remediation scenario will result in an inadequate species composition and cover for most of the dominant species that would be

expected on the SH_T12 sites. As will be discussed in Section 6, however, active restoration will return a significant proportion of expected dominant and sub-dominant species, while intensive restoration will move the site most fully into a restoration trajectory.

Table 4.3.6. Dominant species composition under treatment scenarios, SH T12.

Desired Future Condition	Dominant Habitat Species	Current Species Data*	Exsting Conditions**	Remediation Outcome	Active Restoration	Intensive Restoration
Mesic Douglas fir (1% of area)	Douglas fir	Not Present	-	-	+	+
	Huckleberry	Not Present	-	-	-	+
	Douglas fir	Not Present	-	-	+	+
	Snowberry	Not Present	-	-	+	+
Xeric Douglas fir (11% of area)	Douglas fir	Not Present	-	-	+	+
	Pinegrass	Not Present	-	-	-	+
	Douglas fir	Not Present	-	-	+	+
	Elk sedge	Not Present	-	-	-	+
Xeric Fescue grass (88% of area)	Douglas fir	Not Present	-	-	+	+
	Bluebunch wheatgrass	Not Present	-	+	+	+
	Rough fescue	Not Present	-	-	+	+
	Idaho fescue	Not Present	-	-	+	+

*Average percent cover on proportion of SH_T12 polygons.

** - inadequate cover and presence; + adequate cover and presence.

Given the restoration scenario and the challenging site conditions, BRI recommends the use of enhancement planting of native species both to move the SH_T12 sites more towards a restoration trajectory and to help stabilize the significant erosion problems that are present. In particular, native grass species must be augmented to meet species diversity goals. Tree protectors should be used during planting of woody species to augment microsite availability. Given the large areas of unvegetated ground, the SH_T12 sites could also benefit from broadcast seeding, both to improve ground cover and to reduce erosion. Additionally, site conditions recommend multiple applications of compost, which would significantly improve soil conditions for plants and planting. Multiple applications of slow-release, organic fertilizer would also improve site conditions for growth and survival. Finally, weed control and management will need to be a critical aspect of restoration efforts.

4.4 Stucky Ridge: Till-Twelve Inches (SR_T12)

BRI personnel inventoried 3 SR_T12 polygons on Stucky Ridge, covering 315 of 328 SR_T12 designated, non-ARCO-owned acres on the site. Polygons range in size from 3 acres to 304 acres, with an average size of 105 acres. The elevations of these polygons range from a low of 1570 meters to a high of 1779 meters, with an average elevation of 1650 meters. The average slope is 7%. As shown in **Table 4.4**, while the polygons' surfaces are distributed across all points of the compasses, the fewest surfaces face East.

Table 4.4. Percentage aspect of polygons, Stucky Ridge SR_T12*.

East	West	North	South	Flat
13 (4)	27 (34)	26 (29)	34 (50)	0.1 (0.1)

*Variables are reported as: percent mean (standard deviation).

4.4.1 Dominant Ground Cover

As shown in **Table 4.4.1**, bare soil, rocks and gravel accounts for almost all ground cover on the SR_T12 sites. Together, litter and basal vegetation account for only a trace of ground cover on these polygons. This high proportion of gravel and rocks in these areas presents a significant challenge to restoration.

Table 4.4.1. Percent ground cover, SR_T12*.

Site Count	Soil	Gravel	Rock	Litter	Basal Veg	Wood	Other
3	46 (37)	23 (11)	26 (24)	0 (0)	1 (1)	0 (0)	0 (0)

*Cover is reported as: mean (standard deviation).

4.4.2 Dominant Vegetation Cover

As shown in **Table 4.4.2.1**, an average of only 10% of the SR_T12 sites is covered with native plants, while 2% is covered with exotic plant species. In addition, none of the native life forms meet the standards of restoration for species richness (i.e., five species or more per life form).

Table 4.4.2.1. Plant cover (percent) and richness (count), SR T12*.

Variable	Forbs	Grasses	Woody	Native	Exotic = Exotic Species + Noxious Weeds	Noxious Weeds
Cover	2 (3)	3 (0)	4 (4)	10 (8)	2 (2)	1(1)
Richness	3 (4)	2 (1)	4 (3)	10 (8)	2 (1)	2 (1)

*Variables are reported as: mean (standard deviation).

Given the overall lack of plant cover, no species can be said to dominate the SR_T12 sites. Nonetheless, Table 4.4.2.2 shows the three species that both have the greatest cover and that are present on most SR_T12 sites. Great Basin wildrye (*Leymus cinereus*) and Redtop (*Agrostis stolonifera*) are the most significant grass species, while Wood's rose (*Rosa woodsii*) is the most significant woody species.

Table 4.4.2.2. Dominant plant species, SR T12*.

Species	Percent Cover	Polygon Presence
Great basin wildrye	3 (3)	3
Redtop	1 (2)	3
Wood's rose	1 (1)	2

*Cover is reported as: mean (standard deviation).

This dominant species list is completely comprised of plants that are adapted both to disturbance and to elevated trace element levels.

4.4.3 Erosion Type

As shown in Table 4.4.3, all three SR_T12 sites demonstrate significant gully, rill and sheet erosion.

Table 4.4.3. Erosion types and coverage, SR T12*.

	Gully, Rill & Sheet	TOTAL
Polygon Area Demonstrating Erosion	77 (23)	77 (23)
Count	3	3

*Cover is reported as: mean (standard deviation).

4.4.4. Browse

As shown in **Table 4.4.4**, there is light browse on one SR_T12 site (the 304 acre polygon), but no browse on the other two smaller sites, namely because there were no palatable species present.

Table 4.4.4. Browse, SR T12.

None (< 5 percent)	Light (5-25 percent)	Moderate (25-50 percent)	Heavy (>50 percent)
1	2	-	-

4.4.5 Microsite Availability

As shown in **Table 4.4.5.1**, the two small SR_T12 polygons show an inadequate number of microsites, while the large polygon (304 acres) shows an adequate number of microsites.

Table 4.4.5. Counts of microsites, SR T12.

Adequate	Moderate	Marginal	Inadequate
1	-	-	2

4.4.6 Current and Future Conditions

As shown in **Table 4.4.6**, all of the expected dominant species are currently either absent or present in inadequate proportions. Conservatively, a dominant species' presence is considered inadequate under existing conditions if its current cover is less than 5%, and if it is present on less than 50% of the polygons that were inventoried.

The remediation prescription for these sites calls for tilling the soil to 12 inches, applying lime and/or organic matter, and drill seeding with an upland herbaceous species mix. Crimped or mulched straw will be applied at a rate of one ton per acre in the transition zones above steep slope reclamation areas. Areas of existing trees and acceptable vegetation will not be disturbed.

Given this remediation scenario, a dominant species' future presence will be adequate if its current cover would reasonably permit the spread of this species across the polygon areas. Conservatively, this means 1% or greater current cover, and current presence on 50% or more of the polygons that were inventoried. Currently, none of the expected dominant species display this extent of cover and distribution. Alternatively, a dominant species' future presence will be

adequate if it is included in the drill seed mix specified for the remedial prescription. Of the eight dominant species expected on the SR_T12 sites, however, only bluebunch wheatgrass (*Agropyron spicatum*) is included in the remediation drill seed mix. Further, none of the dominant tree or shrub species that are expected on the SR_T12 sites will be planted under the remedial prescription, nor will any forb seedlings be planted under the remedial prescription.

As a result, future conditions under the proposed remediation scenario will result in an inadequate species composition and cover for most of the dominant species that would be expected on the SR_T12 sites. As will be discussed in **Section 6**, however, active restoration will return a significant proportion of expected dominant and sub-dominant species, while intensive restoration will move the site most fully into a restoration trajectory

Table 4.4.6. Dominant species composition under treatment scenarios, SR T12.

Desired Future Condition	Dominant Habitat Species	Current Species Data*	Existing Conditions**	Remediation Outcome	Active Restoration	Intensive Restoration
Mesic Douglas fir (12% of area)	Douglas fir	Not Present	-	-	+	+
	Huckleberry	Not Present	-	-	-	+
	Douglas fir	Not Present	-	-	+	+
	Snowberry	Not Present	-	-	+	+
Xeric Douglas fir (49% of area)	Douglas fir	Not Present	-	-	+	+
	Pinegrass	Not Present	-	-	-	+
	Douglas fir	Not Present	-	-	+	+
	Elk sedge	Not Present	-	-	-	+
Xeric Fescue grass (41% of area)	Douglas fir	Not Present	-	-	+	+
	Bluebunch wheatgrass	0.2% on 33%	-	+	+	+
	Rough fescue	Not Present	-	-	+	+

*Average percent cover on proportion of SR_T12 polygons.

** - inadequate cover and presence; + adequate cover and presence.

Given the restoration scenario and the challenging site conditions, BRI recommends the use enhancement planting of native species both to move the SR_T12 sites more towards a restoration trajectory and to help stabilize the significant erosion problems that are present. Tree protectors should be used during planting of woody species to augment microsite availability. Given the large areas of unvegetated ground, the SR_T12 sites could also benefit from broadcast seeding, both to improve ground cover and to reduce erosion. Additionally, site conditions

recommend multiple applications of compost, which would significantly improve soil conditions for plants and planting. Multiple applications of slow-release, organic fertilizer would also improve site conditions for growth and survival.

4.5 Smelter Hill: Till-Six Inches (SH_T6)

BRI personnel inventoried 3 SH_T6 polygons on Smelter Hill, covering 15 of 15 SH_T6 designated, non-ARCO-owned acres on the site. Polygons range in size from three acres to eight acres, with an average size of five acres. The elevations of these polygons range from a low of 1650 meters to a high of 1739 meters, with an average elevation of 1700 meters. The average slope is 6%. As shown in **Table 4.5**, while the polygons' surfaces are distributed across all points of the compasses, two-thirds face South and East.

Table 4.5. Percentage aspect of polygons. Smelter Hill SH_T6*.

East	West	North	South
36 (36)	19 (26)	26 (28)	39 (17)

*Variables are reported as: percent mean (standard deviation).

4.5.1 Dominant Ground Cover

As shown in **Table 4.5.1**, soil accounts for over one-half of the polygon's ground cover. Bare soil and gravel accounts for another one-third of ground cover. Together, litter and basal vegetation cover approximately one-eighth of the area.

Table 4.5.1. Percent ground cover, SH_T6*.

Site Count	Soil	Gravel	Rock	Litter	Basal Veg	Wood	Other
3	53 (6)	17 (6)	17 (6)	8 (11)	5 (5)	0 (0)	0 (0)

*Cover is reported as: mean (standard deviation).

4.5.2 Dominant Vegetation Cover

As shown in **Table 4.5.2.1**, an average of only 10% of the SH_T6 sites is covered with native plants, while another 11% is covered with exotic plant species. None of the native life forms meet the standards of restoration for species richness (e.g., five species or more per life form).

Table 4.5.2.1. Plant cover (percent) and richness (count), SH T6*.

Variable	Forbs	Grasses	Woody	Native	Exotic = Exotic Species + Noxious Weeds	Noxious Weeds
Cover	3 (2)	5 (4)	3 (1)	10 (3)	11 (11)	2 (1)
Richness	4 (2)	2 (1)	3 (1)	9 (3)	5 (2)	2 (1)

*Variables are reported as: mean (standard deviation).

Table 4.5.2.2 shows the two species that both have the greatest cover and that are present on most SH_T6 sites. Redtop (*Agrostis stolonifera*) and Great Basin wildrye (*Leymus cinereus*) together account for approximately 13% of canopy cover, and, respectively, are present at 3 and 2 sites.

Table 4.5.2.2. Dominant plant species, SH T6*.

Species	Percent Cover	Polygon Presence
Redtop	9 (10)	3
Great basin wildrye	4 (5)	2

*Cover is reported as: mean (standard deviation).

This dominant species list is completely comprised of plants that are adapted both to disturbance and to elevated trace element levels.

4.5.3 Erosion Type

As shown in Table 4.5.3, the SH_T6 sites demonstrate from minor to significant erosion problems, including rill, gully, and sheet erosion.

Table 4.5.3. Erosion types and coverage, SH T6*.

	Sheet	Gully, Rill & Sheet	TOTAL
Polygon Area Demonstrating Erosion	30 (28)	98 (•)	53 (44)
Count	2	1	3

*Cover is reported as: mean (standard deviation).

• Note: no standard deviation.

4.5.4 Browse

As shown in Table 4.5.4, where browse is present, browse levels on the SH_T6 sites is moderate to heavy. There was no browse on one site, namely because of an absence of palatable species present.

Table 4.5.4. Browse, SH T6.

None (< 5 percent)	Light (5-25 percent)	Moderate (25-50 percent)	Heavy (>50 percent)
1	-	1	1

4.5.5 Microsite Availability

As shown in **Table 4.5.5**, only one SH_T6 polygons shows an adequate number of microsites, while two have an inadequate number.

Table 4.5.5. Counts of microsites, SH T6.

Adequate	Moderate	Marginal	Inadequate
1	-	-	2

4.5.6 Current and Future Conditions

As shown in **Table 4.5.6**, none of the expected dominant species are currently present on the SH_T6 sites. The remediation prescription for these sites calls for tilling the soil to 6 inches, applying lime and/or organic matter, and drill seeding with an upland herbaceous species mix. Crimped or mulched straw will be applied at a rate of one ton per acre in the transition zones above steep slope reclamation areas. Areas of existing trees and acceptable vegetation will not be disturbed.

Given this remediation scenario and the current absence of expected dominant species, the presence of a dominant species on the SH_T6 sites will be assured only if it is included in the drill seed mix specified for the remedial prescription. Of the six dominant species expected on the SH_T6 sites, only bluebunch wheatgrass (*Agropyron spicatum*) is included in the remediation drill seed mix. Further, none of the dominant tree or shrub species that are expected on the SR_T12 sites will be planted under the remedial prescription, nor will any forb seedlings be planted under the remedial prescription.

As a result and as shown in **Table 4.5.6**, future conditions under the proposed remediation scenario will result in an inadequate species composition and cover for most of the dominant species that would be expected on the SH_T6 sites. As will be discussed in **Section 6**, however,

active restoration will return a significant proportion of expected dominant and sub-dominant species, while intensive restoration will move the site most fully into a restoration trajectory.

Table 4.5.6. Dominant species composition under treatment scenarios, SH T6.

Desired Future Condition	Dominant Habitat Species	Current Species Data*	Existing Conditions**	Remediation Outcome	Active Restoration	Intensive Restoration
Xeric Douglas fir (27% of area)	Douglas fir	Not Present	-	-	+	+
	Pinegrass	Not Present	-	-	-	+
	Douglas fir	Not Present	-	-	+	+
	Elk sedge	Not Present	-	-	-	+
	Douglas fir	Not Present	-	-	+	+
	Bluebunch wheatgrass	Not Present	-	+	+	+
Xeric Fescue grass (73% of area)	Idaho fescue	Not Present	-	-	+	+
	Bluebunch wheatgrass	Not Present	-	+	+	+
	Rough fescue	Not Present	-	-	+	+

*Average percent cover on proportion of SH_T6 polygons.

** - inadequate cover and presence; + adequate cover and presence.

Given the restoration scenario and the challenging site conditions, BRI recommends the use enhancement planting of native species both to move the SH_T6 sites more towards a restoration trajectory and to help stabilize the significant erosion problems. Tree protectors should be used during planting to augment microsite availability and to provide browse protection. Given the large areas of unvegetated ground, the SH_T6 sites could also benefit from broadcast seeding, both to improve ground cover and to reduce erosion. Additionally, site conditions recommend multiple applications of compost, which would significantly improve soil conditions for plants and planting. Multiple applications of slow-release, organic fertilizer would also improve site conditions for growth and survival.

4.6 Stucky Ridge: Till-Six Inches (SR_T6)

BRI personnel inventoried 5 SR_T6 polygons on Stucky Ridge, covering 239 of 251 SR_T6 designated, non-ARCO-owned acres on the site. Polygons range in size from 4 acres to 105 acres, with an average size of 48 acres. The elevations of these polygons range from a low of 1570 meters to a high of 1809 meters, with an average elevation of 1693 meters. The average slope is 10%. As shown in **Table 4.6**, while the polygons' surfaces are distributed across all points of the compasses, one-half of the surfaces face East and one-fourth face North.

Table 4.6. Percentage aspect of polygons, Stucky Ridge SR_T6*.

East	West	North	South	Flat
50 (35)	14 (17)	24 (19)	13 (21)	0.1 (0.2)

*Variables are reported as: percent mean (standard deviation).

4.6.1 Dominant Ground Cover

As shown in **Table 4.6.1**, bare soil and gravel accounts for almost all ground cover on the SR_T6 sites. Together, litter and basal vegetation cover less than 10% of the area.

Table 4.6.1. Percent ground cover, SR_T6*.

Site Count	Soil	Gravel	Rock	Litter	Basal Veg	Wood	Other
5	80 (17)	9 (9)	1 (1)	2 (1)	5 (3)	0 (1)	0 (0)

*Cover is reported as: percent mean (standard deviation).

4.6.2 Dominant Vegetation Cover

As shown in **Table 4.6.2.1**, an average of only 14% of the SR_T6 sites is covered with native plants. None of the native life forms meet the standards of restoration for species richness (i.e., five species or more per life form). Nine percent of the sites is covered with exotic plant species, of which one-half are noxious weed species.

Table 4.6.2.1. Plant cover (percent) and richness (cover), SR_T6*.

Variable	Forbs	Grasses	Woody	Native	Exotic = Exotic Species + Noxious Weeds	Noxious Weeds
Cover	2 (2)	5 (5)	5 (4)	14 (8)	9 (3)	3 (2)
Richness	4 (3)	2 (1)	4 (3)	11 (7)	4 (1)	2 (1)

*Variables are reported as: mean (standard deviation).

Table 4.6.2.2 shows the four species that both have the greatest cover and that are present on most SR_T6 sites. Redtop (*Agrostis stolonifera*) and great basin wildrye (*Leymus cinereus*) together account for approximately 10% of canopy cover. Hoary pepperwort (*Cardaria draba*) contributes an average of 2% cover, but is present on all five sites. Wood's rose (*Rosa woodsii*) has the greatest average canopy cover of all woody species present (3%), although it is only present at two of five sites.

Table 4.6.2.2. Dominant plant species, SR T6*.

Species	Percent Cover	Polygon Presence
Redtop	5 (5)	4
Great basin wildrye	5 (5)	4
Hoary pepperwort	2 (1)	5
Wood's rose	3 (4)	2

*Cover is reported as: mean (standard deviation).

This dominant species list is completely comprised of plants that are adapted both to disturbance and to elevated trace element levels. In addition to the broad distribution of hoary pepperwort, the sites show total weed canopy coverage of nine acres, spread widely across all of the polygons. This indicates that there is a significant noxious weed infestation problem on the SR_T6 sites.

4.6.3 Erosion Type

As shown in **Table 4.6.3**, the SR_T6 sites demonstrate a wide range of erosion conditions, including rill, gully, sheet and wind erosion. One of the five sites showed no erosion, but the other four sites evidenced erosion across a large portion of their surface areas.

Table 4.6.3. Erosion types and coverage (percent), SR T6*.

	None	Rill	Gully, Rill & Sheet	Wind	TOTAL
Polygon Area Demonstrating Erosion	0 (•)	70 (•)	65 (21)	98 (•)	60 (38)
Count	1	1	2	1	5

*Cover is reported as: percent mean (standard deviation).

• Note: no standard deviation.

4.6.4 Browse

As shown in **Table 4.6.4**, browse levels on two of the SR_T6 sites is moderate, and on one of the sites is heavy. There was no browse on the other two sites, namely because there were no palatable species present.

Table 4.6.4. Browse, SR T6.

None (< 5 percent)	Light (5-25 percent)	Moderate (25-50 percent)	Heavy (>50 percent)
2	-	2	1

4.6.5 Microsite Availability

As shown in **Table 4.6.5**, only one SR_T6 polygons shows an adequate number of microsites. Two show a moderate number and two show a marginal number of microsites.

Table 4.6.5. Counts of microsites, SR_T6.

Adequate	Moderate	Marginal	Inadequate
1	2	2	-

4.6.6 Current and Future Conditions

As shown in **Table 4.6.6**, all of the expected dominant species are currently either absent or present in inadequate proportions. Conservatively and for the purpose of this analysis, a dominant species' presence is considered inadequate under existing conditions if its current cover is less than 5%, and if it is present on less than 50% of the polygons that were inventoried.

The remediation prescription for these sites calls for tilling the soil to 6 inches, applying lime and/or organic matter, and drill seeding with an upland herbaceous species mix. Crimped or mulched straw will be applied at a rate of one ton per acre in the transition zones above steep slope reclamation areas. Areas of existing trees and acceptable vegetation will not be disturbed. Given this remediation scenario, a dominant species' future presence will be adequate if its current cover will reasonably permit the spread of this species across the polygon areas. Conservatively and for the purpose of this analysis, this means 1% or greater current cover, and current presence on 50% or more of the polygons that were inventoried. None of the expected dominant species present these levels of cover or presence. Alternatively, the presence of a dominant species on the SH_T6 sites would be assured if it is included in the drill seed mix specified for the remedial prescription. Of the eight dominant species expected on the SH_T6 sites, however, only bluebunch wheatgrass (*Agropyron spicatum*) is included in the remediation drill seed mix. Further, none of the dominant tree or shrub species that are expected on the SR_T12 sites will be planted under the remedial prescription, nor will any forb seedlings be planted under the remedial prescription.

As a result and as shown in **Table 4.6.6**, future conditions under the proposed remediation scenario will result in an inadequate species composition and cover for most of the dominant species that would be expected on the SH_MWV sites. As will be discussed in **Section 6**, however, active restoration will return a significant proportion of expected dominant and sub-dominant species, while intensive restoration will move the site most fully into a restoration trajectory.

Table 4.6.6. Dominant species composition under treatment scenarios, SR_T6.

Desired Future Condition	Dominant Habitat Species	Current Species Data*	Existing Conditions**	Remediation Outcome	Active Restoration	Intensive Restoration
Mesic Douglas fir (5% of area)	Douglas fir	0.1% on 20%	-	-	+	+
	Huckleberry	Not Present	-	-	-	+
	Douglas fir	0.1% on 20%	-	-	+	+
	Snowberry	Not Present	-	-	+	+
Xeric Douglas fir (30% of area)	Douglas fir	0.1% on 20%	-	-	+	+
	Pinegrass	Not Present	-	-	-	+
	Douglas fir	0.1% on 20%	-	-	+	+
	Elk sedge	Not Present	-	-	-	+
	Douglas fir	0.1% on 20%	-	-	+	+
	Bluebunch wheatgrass	0.1% on 20%	-	+	+	+
Xeric Fescue grass (64% of area)	Idaho fescue	Not Present	-	-	+	+
	Bluebunch wheatgrass	0.1% on 20%	-	+	+	+
	Rough fescue	Not Present	-	-	+	+

*Average percent cover on proportion of SR_T6 polygons.

** - inadequate cover and presence; + adequate cover and presence.

Given the restoration scenario and the challenging site conditions, BRI recommends the use enhancement planting of native species both to move the SR_T6 sites more towards a restoration trajectory and to help stabilize the significant erosion problems. Tree protectors should be used during planting to augment microsite availability and to provide browse protection. Given the large areas of unvegetated ground, the SR_T6 sites could also benefit from broadcast seeding, both to improve ground cover and to reduce erosion. Additionally, site conditions recommend multiple applications of compost, which would significantly improve soil conditions for plants and planting. Multiple applications of slow-release, organic fertilizer would also improve site

conditions for growth and survival. Finally, weed control and management will need to be a critical aspect of restoration efforts.

4.7 Smelter Hill: Vegetation Improvement (SH_VI)

BRI personnel inventoried 3 SH_VI polygons on Smelter Hill, covering 53 of 82 SH_VI designated, non-ARCO-owned acres on the site. Polygons range in size from 12 acres to 23 acres, with an average size of 18 acres. The elevations of these polygons range from a low of 1650 meters to a high of 1829 meters, with an average elevation of 1725 meters. The average slope is 8%. As shown in **Table 4.7**, almost all of the polygons' surfaces face South and East.

Table 4.7. Percentage aspect of polygons, SH_VI*.

East	West	North	South
41 (27)	3 (2)	3 (4)	54 (27)

*Variables are reported as: percent mean (standard deviation).

4.7.1 Dominant Ground Cover

As shown in **Table 4.7.1**, bare soil accounts for nearly three-fourths of ground cover on the SH_VI sites. Gravel and rock are a minor component of the site. Litter and basal vegetation cover, however, cover approximately one-fourth of the area. The relative dearth of plant cover given the low levels of gravel and rock and the strong soil cover values suggest that the soils may be a limiting factor for plant growth.

Table 4.7.1. Percent ground cover, SH_VI*.

Site Count	Soil	Gravel	Rock	Litter	Basal Veg	Wood	Other
3	73 (6)	1 (1)	1 (0)	14 (11)	13 (6)	0 (0)	0 (0)

*Cover is reported as: percent mean (standard deviation).

4.7.2 Dominant Vegetation Cover

As shown in **Table 4.7.2.1**, an average of 20% of the SH_VI sites is covered with native plants, while another 20% is covered with exotic plant species. Noxious weeds comprise a substantial proportion of the exotic plant presence, covering 7% of the polygons, and accounting for three of four exotic species. Nonetheless, all three native plant life forms meet the standards of restoration (i.e., five species or more per life form).

Table 4.7.2.1. Plant cover () and richness (count), SH_VI *.

Variable	Forbs	Grasses	Woody	Native	Exotic = Exotic Species + Noxious Weeds	Noxious Weeds
Cover	4 (2)	10 (9)	6 (4)	20 (8)	20 (11)	7 (4)
Richness	6 (4)	6 (3)	5 (1)	18 (7)	4 (2)	3 (0)

*Variables are reported as: mean (standard deviation).

Table 4.7.2.2 shows the three species that both have the greatest cover and that are present on most SH_VI sites. Redtop (*Agrostis stolonifera*) and Great basin wildrye (*Leymus cinerus*) together account for nearly 20% of canopy cover on the sites, and occur on all 3 sites. Leafy spurge (*Euphorbia esula*) is also present on all three SH_VI polygons with an average cover of 5%.

Table 4.7.2.2. Dominant plant species, SH_VI *.

Species	Percent Cover	Polygon Presence
Redtop	11 (9)	3
Great basin wildrye	8 (11)	3
Leafy spurge	5 (5)	3

*Cover is reported as: mean (standard deviation).

This dominant species list is completely comprised of plants that are adapted both to disturbance and to elevated trace element levels. In addition, the data and field notes indicate that the SH_VI sites have a significant noxious weed infestation problem. For instance, five of seven noxious weeds found on Smelter Hill are found on the SH_VI sites. These weeds cover nearly 10 acres, spread widely across all SH_VI sites. This indicates that there is a significant noxious weed infestation problem on the SH_VI polygons.

4.7.3 Erosion Type

As shown in **Table 4.7.3**, all three of the SH_VI sites demonstrate erosion problems. Sheet erosion is very significant on two of the sites, while sheet and gully erosion is a minor problem on the third site.

Table 4.7.3. Erosion types and coverage (percent), SH_VI*.

	Sheet & Rill	Sheet & Gully	TOTAL
Polygon Area Demonstrating Erosion	50 (28)	10 (•)	37 (31)
Count	2	1	3

*Cover is reported as: mean (standard deviation).

• Note: no standard deviation.

4.7.4 Browse

As shown in **Table 4.7.4**, on one site, browse is light, on another, moderate. No browse value was recorded at the third site, namely because of lack of any palatable plants to examine for browse.

Table 4.7.4. Browse, SH_VI.

None (< 5 percent)	Light (5-25 percent)	Moderate (25-50 percent)	Heavy (>50 percent)
1	1	1	-

4.7.5 Microsite Availability

As shown in **Table 4.7.5**, two of the SH_VI polygons have a moderate numbers of microsites, while one site has an inadequate number of microsites.

Table 4.7.5. Counts of microsites, SH_VI.

Adequate	Moderate	Marginal	Inadequate
-	2	-	1

4.7.6 Current and Future Conditions

As shown in **Table 4.7.6**, all of the expected dominant species are currently either absent or present in inadequate proportions on the SH_VI sites. Conservatively and for the purpose of this analysis, a dominant species' presence is considered inadequate under existing conditions if its current cover is less than 5%, and if it is present on less than 50% of the polygons that were inventoried.

The remediation prescription for these sites calls for a minimal level of treatment based on the following four different scenarios:

- Weed spraying as necessary, 4-6 inches of light tilling with possible lime and/or fertilizer amendments, and drill seeding;
- Weed spraying as necessary, surface scarification with possible lime and/or fertilizer, and drill seeding;
- Weed spraying as necessary, surface scarification with broadcast seeding and fertilization; and,
- Weed spraying as necessary, broadcast seeding and/or broadcast fertilization.

Given this remediation scenario, a dominant species' future presence will be adequate if its current cover would reasonably permit the spread of this species across the polygon areas. Conservatively, this means 1% or greater current cover, and current presence on 50% or more of the polygons that were inventoried. Currently, only Snowberry (*Symphoricarpos albus*) of the list of expected dominant species displays this extent of cover and distribution. Alternatively, a dominant species' future presence will be adequate if it is included in the drill seed mix specified for the remedial prescription. Of the eight dominant species expected on the SH_VI sites, however, only bluebunch wheatgrass (*Agropyron spicatum*) is included in the remediation drill seed mix.

As a result and as shown in **Table 4.7.6**, future conditions under the proposed remediation scenario will result in an inadequate species composition and cover for most of the dominant species that would be expected on the SH_VI sites. As will be discussed in **Section 6**, however, active restoration will return a significant proportion of expected dominant and sub-dominant species, while intensive restoration will move the site most fully into a restoration trajectory.

Table 4.7.6. Dominant species composition under treatment scenarios, SH_VI.

Desired Future Condition	Dominant Habitat Species	Current Species Data*	Existing Conditions**	Remediation Outcome	Active Restoration	Intensive Restoration
Mesic Douglas fir (28% of area)	Douglas fir	Not Present	-	-	+	+
	Huckleberry	Not Present	-	-	-	+
	Douglas fir Snowberry	Not Present 1.2% on 67%	- -	- +	+	+
Xeric Douglas fir (28% of area)	Douglas fir	Not Present	-	-	+	+
	Pinegrass	Not Present	-	-	-	+
	Douglas fir Elk sedge	Not Present Not Present	- -	- -	+	+
	Douglas fir Bluebunch wheatgrass	Not Present 0.2% on 33%	- -	- +	+	+
Xeric Fescue grass (43% of area)	Idaho fescue	0.2% on 33%	-	-	+	+
	Bluebunch wheatgrass	0.2% on 33%	-	+	+	+
	Rough fescue	0.2% on 33%	-	-	+	+

*Average percent cover on proportion of SH_VI polygons.

** - inadequate cover and presence; + adequate cover and presence.

Given the restoration scenario and the challenging site conditions, BRI recommends the use enhancement planting of native species both to move the SH_VI sites more towards a restoration trajectory and to help stabilize the significant erosion problems. Tree protectors should be used during planting to provide browse protection and to augment microsite availability. Given the large areas of unvegetated ground, the SH_VI sites could also benefit from broadcast seeding, both to improve ground cover and to reduce erosion. Additionally, site conditions recommend the mechanical application of compost, which would significantly improve soil conditions for plants and planting. The addition of fertilizer a few years after planting would also improve site conditions for growth and survival. Finally, weeds are the most significant ecological challenge to restoration on the SH_VI sites, and will require active management and monitoring.

4.8 Stucky Ridge: Vegetation Improvement (SR_VI)

BRI personnel inventoried 4 SR_VI polygons on Stucky Ridge, covering 87 of 105 SR_VI designated, non-ARCO-owned acres on the site. Polygons range in size from 12 acres to 40 acres, with an average size of 22 acres. The elevations of these polygons range from a low of 1540 meters to a high of 1809 meters, with an average elevation of 1701 meters. The average slope is 10%. As shown in **Table 4.8**, almost all of the polygons' surfaces face East and South.

Table 4.8. Percentage aspect of polygons, SR_VI*.

East	West	North	South
53 (26)	4 (4)	0 (0)	43 (29)

*Variables are reported as: percent mean (standard deviation).

4.8.1 Dominant Ground Cover

As shown in Table 4.8.1, bare soil accounts for one-half of ground cover on the SR_VI sites. Together, litter and basal vegetation cover approximately one-sixth of the area. Together, gravel and rock account for approximately one-third of the ground cover on site, which may present significant challenges to restoration.

Table 4.8.1. Percent ground cover, SR_VI*.

Site Count	Soil	Gravel	Rock	Litter	Basal Veg	Wood	Other
4	50 (14)	25 (19)	6 (8)	4 (3)	13 (8)	1 (1)	0 (1)

*Cover is reported as: percent mean (standard deviation).

4.8.2 Dominant Vegetation Cover

As shown in Table 4.8.2.1, an average of 16% of the SR_VI sites is covered with native plants, while 29% is covered with exotic plant species. Noxious weeds comprise a substantial proportion of the exotic plant presence, covering 18% of the polygons. In addition, neither native forb nor native grass richness meets the standards of restoration, while native woody plant richness barely meets the standards of restoration (i.e., five species or more per life form), while covering an average of less than 10% of the sites.

Table 4.8.2.1. Plant cover (percent) and richness (count), SR_VI*.

Variable	Forbs	Grasses	Woody	Native	Exotic = Exotic Species + Noxious Weeds	Noxious Weeds
Cover	1 (1)	6 (4)	8 (6)	16 (9)	29 (10)	18 (8)
Richness	2 (2)	1 (0)	5 (2)	9 (3)	3 (1)	1 (1)

*Variables are reported as: mean (standard deviation).

Table 4.8.2.2 shows the five species that both have the greatest cover and that are present on most SR_VI sites. Spotted knapweed (*Centaurea maculosa*) has the greatest average canopy cover of all species present (13%), and is present on all 4 SR_VI sites. Leafy spurge (*Euphorbia esula*) is also strongly present, occurring on three of four polygons with an average cover of 3%.

Great basin wildrye (*Leymus cinereus*) and Redtop (*Agrostis stolonifera*) together account for another 11% of canopy cover. Rubber rabbitbrush (*Chrysothamnus nauseosus*) has the greatest average canopy cover of all woody species present (4%), although it is present on only three sites.

Table 4.8.2.2. Dominant plant species, SR_VI *

Species	Percent Cover	Polygon Presence
Spotted knapweed	13 (8)	4
Great basin wildrye	7 (4)	4
Redtop	4 (4)	4
Rubber rabbitbrush	4 (4)	3
Leafy spurge	3 (5)	3

*Cover is reported as: mean (standard deviation).

The data and field notes indicate that the SR_VI sites have a significant noxious weed infestation problem. Not only is spotted knapweed significantly present, Hoary pepperwort (*Cardaria draba*) and Leafy spurge (*Euphorbia esula*) are also considerably at hand. Further, these weedy species are spread widely across all SR_VI sites.

4.8.3 Erosion Type

As shown in **Table 4.8.3**, all of the SR_VI sites demonstrate erosion problems. Most significantly, one-half of the sites show sheet and gully erosion across an average of one-half of the polygons' surface area. Also, bare soil, gravel and rocks account for over 80% of the ground cover of these polygons.

Table 4.8.3. Erosion types and coverage (percent), SR_VI*

	Sheet	Sheet & Gully	TOTAL
Polygon Area Demonstrating Erosion	30 (28)	50 (14)	40 (22)
Count	2	2	4

*Cover is reported as: mean (standard deviation).

4.8.4 Browse

As shown in **Table 4.8.4**, browse levels on three of the four SR_VI sites is moderate. There was no browse on the fourth site, namely because there were no palatable plants to browse.

Table 4.8.4. Browse, SR VI.

None (< 5 percent)	Light (5-25 percent)	Moderate (25-50 percent)	Heavy (>50 percent)
1	-	3	-

4.8.5 Microsite Availability

As shown in **Table 4.8.5**, three of four SR_VI polygons have a moderate numbers of microsites, while one site has an adequate number of microsites.

Table 4.8.5. Counts of microsites, SR VI.

Adequate	Moderate	Marginal	Inadequate
1	3	-	-

4.8.6 Current and Future Conditions

As shown in **Table 4.8.6**, all of the expected dominant species are currently either absent or present in inadequate proportions on the SR_VI sites. Conservatively and for the purpose of this analysis, a dominant species' presence is considered inadequate under existing conditions if its current cover is less than 5%, and if it is present on less than 50% of the polygons that were inventoried.

The remediation prescription for these sites calls for a minimal level of treatment based on the following four different scenarios:

- Weed spraying as necessary, 4-6 inches of light tilling with possible lime and/or fertilizer amendments, and drill seeding;
- Weed spraying as necessary, surface scarification with possible lime and/or fertilizer, and drill seeding;
- Weed spraying as necessary, surface scarification with broadcast seeding and fertilization; and,
- Weed spraying as necessary, broadcast seeding and/or broadcast fertilization.

Given this remediation scenario, a dominant species' future presence will be adequate if its current cover would reasonably permit the spread of this species across the polygon areas. Conservatively, this means 1% or greater current cover, and current presence on 50% or more of

the polygons that were inventoried. Currently, none of the expected dominant species display this extent of cover and distribution. Alternatively, a dominant species' future presence will be adequate if it is included in the drill seed mix specified for the remedial prescription. Of the eight dominant species expected on the SH_T6 sites, however, only bluebunch wheatgrass (*Agropyron spicatum*) is included in the remediation drill seed mix.

As a result and as shown in **Table 4.8.6**, future conditions under the proposed remediation scenario will result in an inadequate species composition and cover for most of the dominant species that would be expected on the SH_T6 sites. As will be discussed in **Section 6**, however, active restoration will return a significant proportion of expected dominant and sub-dominant species, while intensive restoration will move the site most fully into a restoration trajectory.

Table 4.8.6. Dominant species composition under treatment scenarios, SR_VI.

Desired Future Condition	Dominant Habitat Species	Current Species Data*	Existing Conditions**	Remediation Outcome	Active Restoration	Intensive Restoration
Mesic Douglas fir (3% of area)	Douglas fir	0.1% on 25%	-	-	+	+
	Huckleberry	Not Present	-	-	-	+
	Douglas fir	0.1% on 25%	-	-	+	+
	Snowberry	0.1% on 25%	-	-	+	+
Xeric Douglas fir (38% of area)	Douglas fir	0.1% on 25%	-	-	+	+
	Pinegrass	Not Present	-	-	-	+
	Douglas fir	0.1% on 25%	-	-	+	+
	Elk sedge	Not Present	-	-	-	+
	Douglas fir	0.1% on 25%	-	-	+	+
Xeric Fescue grass (59% of area)	Bluebunch wheatgrass	0.1% on 25%	-	+	+	+
	Idaho fescue	Not Present	-	-	+	+
	Bluebunch wheatgrass	0.1% on 25%	-	+	+	+
	Rough fescue	Not Present	-	-	+	+

*Average percent cover on proportion of SR_VI polygons.

** - inadequate cover and presence; + adequate cover and presence.

Given the restoration scenario and the challenging site conditions, BRI recommends the use enhancement planting of native species both to move the SR_VI sites more towards a restoration trajectory and to help stabilize the significant erosion problems. Tree protectors should be used during planting to provide browse protection and to augment microsites where their density is insufficient. Given the large areas of unvegetated ground, the SR_VI sites could also benefit from broadcast seeding, both to improve ground cover and to reduce erosion. Additionally, site

conditions recommend the mechanical application of compost, which would significantly improve soil conditions for plants and planting. The addition of fertilizer a few years after planting would also improve site conditions for growth and survival. Finally, weeds are the most significant ecological challenge to restoration on the SR_VI sites, and will require active management and monitoring.

4.9 Smelter Hill: Steep Slope Restoration (SH_SSR)

BRI personnel inventoried 14 SH_SSR polygons on Stucky Ridge, covering 485 of 579 SH_SSR designated, non-ARCO-owned acres on the site. Polygons range in size from 12 acres to 95 acres, with an average size of 35 acres. The elevations of these polygons range from a low of 1590 meters to a high of 2009 meters, with an average elevation of 1772. The average slope is 18%. As shown in Table 4.9, while the polygons' surface areas face all points of the compass, although relatively few sites face West.

Table 4.9. Percentage aspect of polygons, SH SSR*.

East	West	North	South
26 (25)	9 (23)	30 (41)	35 (36)

*Variables are reported as: percent mean (standard deviation).

4.9.1 Dominant Ground Cover

As shown in Table 4.9.1, bare soil accounts for over nearly two-fifths of ground cover on the SH_SSR sites. Together, gravel and rock account for almost over two-fifths of the ground cover on site, while litter and basal vegetation cover only one-fifth of the area.

Table 4.9.1. Percent ground cover, SH SSR*.

Site Count	Soil	Gravel	Rock	Litter	Basal Veg	Wood	Other
14	39 (30)	20 (13)	25 (23)	9 (11)	12 (8)	2 (1)	0 (0)

*Cover is reported as: percent mean (standard deviation).

4.9.2 Dominant Vegetation Cover

As shown in Table 4.9.2.1, just over one-fourth of the SH_SSR sites is covered with native plants, while just over one-tenth is covered with exotic plant species. A majority of the exotic plant cover is contributed by weedy species, especially leafy spurge (*Euphorbia esula*) and

spotted knapweed (*Centaurea maculosa*). Nonetheless, both native forbs and woody plants meet the richness standards for restoration (i.e., five species or more per life form). Among plant life forms, only the grasses do not meet richness restoration standards.

Table 4.9.2.1. Plant cover (percent) and richness (count), SH SSR*.

Variable	Forbs	Grasses	Woody	Native	Exotic = Exotic Species + Noxious Weeds	Noxious Weeds
Cover	4 (3)	11 (10)	11 (9)	26 (14)	11 (9)	7 (8)
Richness	6 (3)	3 (2)	7 (3)	16 (6)	4 (2)	2 (1)

*Variables are reported as: mean (standard deviation).

Table 4.9.2.2 shows the three species that both have the greatest cover and that are present on most SH_SSR sites. Great Basin wildrye (*Leymus cinereus*) has the greatest average canopy cover of all species present (9%), and is present on 12 SH_SSR sites. Redtop (*Agrostis stolonifera*) is the second most dominant grass with only 2% of canopy cover, but presence on 12 sites. As previously noted, Leafy spurge and Spotted knapweed are widely present on site, together accounting for 6% of cover. Quaking aspen (*Populus tremuloides*) has the greatest average canopy cover of all woody species present (3%), and is present on eight sites.

Table 4.9.2.2. Dominant Plant Species, SH SSR*.

Species	Percent Cover	Polygon Presence
Great basin wildrye	9 (10)	12
Leafy spurge	4 (7)	9
Quaking aspen	3 (6)	8
Redtop	2 (3)	12
Spotted knapweed	2 (3)	12

*Cover is reported as: mean (standard deviation).

The data and field notes indicate that the SH_SSR sites have a significant noxious weed infestation problem. A total of 5 noxious weed species are present, which cover an area of 42 acres well distributed across the SH_SSR polygons.

4.9.3 Erosion Type

As shown in **Table 4.9.3**, almost all of the SH_SSR sites demonstrate significant erosion problems. While the types of erosion vary, erosion features are widely present across the SH_SSR sites.

Table 4.9.3. Erosion types and coverage (percent), SH_SSR*.

	Sheet	Sheet & Rill	Sheet & Gully	Gully, Rill & Sheet	Wind	Soil Creep	TOTAL
Polygon Area Demonstrating Erosion	62 (37)	70 (28)	74 (34)	55 (50)	84 (20)	0.5 (•)	63 (35)
Count	5	2	2	2	2	1	14

*Cover is reported as: percent mean (standard deviation).

• Note: no standard deviation.

4.9.4 Browse

As shown in **Table 4.9.4**, browse levels on the SH_SSR sites widely vary. Where palatable plant species occur, browse is light to heavy. Field notes indicate that, for the most part, where no browse occurred, few palatable plant species were present.

Table 4.9.4. Browse, SH_SSR.

None (< 5 percent)	Light (5-25 percent)	Moderate (25-50 percent)	Heavy (>50 percent)
3	5	4	2

4.9.5 Microsite Availability

As shown in **Table 4.9.5**, the SH_SSR polygons are evenly distributed across the full range of microsite diversity

Table 4.9.5. Counts of microsites, SH_SSR.

Adequate	Moderate	Marginal	Inadequate
3	5	3	3

4.9.6 Current and Future Conditions

As shown in **Table 4.9.6**, all of the expected dominant species are currently either absent or present in inadequate proportions on the SH_SSR sites. Conservatively and for the purpose of this analysis, a dominant species' presence is considered inadequate under existing conditions if

its current cover is less than 5%, and if it is present on less than 50% of the polygons that were inventoried.

The remediation prescription for these sites calls for planting of trees and shrubs, and broadcast seeding. Given this scenario, a dominant species' future presence would be adequate if it is directly planted, or if it is included in the seed mix specified for the remedial prescription. Of the twelve dominant species expected on the SH_SSR sites, however, only Douglas fir (*Pseudotsuga menziesii*), Lodgepole pine (*Pinus contorta*), and bluebunch wheatgrass (*Agropyron spicatum*) will either be planted or seeded.

Alternatively, a dominant species' future presence will be adequate if its current cover would reasonably permit the spread of this species across the polygon areas. Conservatively, this means 1% or greater current cover, and current presence on 50% or more of the polygons that were inventoried. None of the expected dominant species that are currently present on site, however, display this extent of cover and distribution.

As a result and as shown in **Table 4.9.6**, future conditions under the proposed remediation scenario will result in an inadequate species composition and cover for several of the dominant species that would be expected on the SH_SSR sites. As will be discussed in **Section 6**, however, active restoration will return a significant proportion of expected dominant and sub-dominant species, while intensive restoration will move the site most fully into a restoration trajectory.

Table 4.9.6. Dominant species composition under treatment scenarios, SH_SSR.

Desired Future Condition	Dominant Habitat Species	Current Species Data*	Existing Conditions**	Remediation Outcome	Active Restoration	Intensive Restoration
Mesic Douglas fir (19% of area)	Douglas fir	0.3% on 21%	-	+	+	+
	Huckleberry	Not Present	-	-	-	+
	Douglas fir Snowberry	0.3% on 21% 0.6% on 50%	- -	+	+	+
Xeric Douglas fir (24% of area)	Douglas fir	0.3% on 21%	-	+	+	+
	Pinegrass	0.1% on 14%	-	-	-	+
	Douglas fir Elk sedge	0.3% on 21% Not Present	- -	+	+	+
	Douglas fir Bluebunch wheatgrass	0.3% on 21% 0.1% on 29%	- -	+	+	+
Xeric Fescue grass (52% of area)	Idaho fescue	Not Present	-	-	+	+
	Bluebunch wheatgrass	0.1% on 29%	-	+	+	+
	Rough fescue	0.3% on 14%	-	-	+	+
Mesic Fescue grass (1% of area)	Idaho fescue	Not Present	-	-	+	+
	Rough fescue	0.3% on 14%	-	-	+	+
Lodgepole pine (1% of area)	Lodgepole pine	0.3% on 14%	-	+	+	+
	Twinflower	Not Present	-	-	-	+
	Lodgepole pine	0.3% on 29%	-	+	+	+
	Grouse whortleberry	Not Present	-	-	-	+
	Lodgepole pine Pinegrass	0.3% on 29% 0.4% on 7%	- -	+	+	+
Lodgepole pine/ Douglas fir (1% of area)	Lodgepole pine	0.3% on 14%	-	+	+	+
	Douglas fir	0.3% on 21%	-	+	+	+
	Twinflower	Not Present	-	-	-	+
	Lodgepole pine	0.3% on 14%	-	+	+	+
	Douglas fir	0.3% on 21%	-	+	+	+
	Grouse whortleberry	Not Present	-	-	-	+
	Lodgepole pine Douglas fir Pinegrass	0.3% on 14% 0.3% on 21% 0.4% on 7%	- - -	+	+	+

*Average percent cover on proportion of SH_SSR polygons.

** - inadequate cover and presence; + adequate cover and presence.

Given the restoration scenario and the challenging site conditions, BRI recommends the use enhancement planting of native species both to move the SH_SSR sites more towards a restoration trajectory and to help stabilize the significant erosion problems. In particular, the diversity of site-appropriate native grasses needs augmentation. The enhancement planting will add to the plantings that will occur under the remediation scenario, and will expand species

diversity and provide a greater density of cover. Tree protectors should be used during planting of trees and shrubs both to provide browse protection and to augment microsite availability.

BRI's recommended remediation activities are based on the anticipation that brush boxes, dozer basins and other measures will control erosion on the slopes of the SH_SSR sites. Nonetheless, the soils of the SH_SSR sites will require amendment prior to planting. Unfortunately, the decision tree for the remediation scenario breaks out steep slope polygons before liming becomes a management option. Given the limits to ground access due to steep slopes, however, those SH_SSR polygons that show elevated trace element levels and high soil acidity should receive aerial lime application as a soil amendment under the remediation scenario. This will help neutralize acidity and reduce trace element availability, both of which would significantly improve soil conditions for plant growth and survival.

The high composition of gravel and rock will also present challenges to restoration. Such conditions, plus limits to ground access due to steep slopes, recommend the aerial application of compost, which would also improve soil conditions for plants and planting. The SH_SSR sites would also benefit from aerial seeding, both to improve ground cover and to reduce erosion. In addition, the aerial addition of fertilizer would augment conditions for growth and survival. Finally, weeds are a significant ecological challenge to restoration on the SH_SSR sites, and will require active management and monitoring.

4.10 Stucky Ridge: Steep Slope Restoration (SR_SSR)

BRI personnel inventoried 14 SR_SSR polygons on Stucky Ridge, covering 438 of 498 SR_SSR designated, non-ARCO-owned acres on the site. Polygons range in size from 7 acres to 102 acres, with an average size of 31 acres. The elevations of these polygons range from a low of 1540 meters to a high of 1809 meters, with an average elevation of 1678 meters. The average slope is 16%. As shown in **Table 4.10**, while the polygons' surface areas face all points of the compass, a majority of surfaces face North and East.

Table 4.10. Percentage aspect of polygons, SR SSR*.

East	West	North	South
26 (26)	12 (27)	45 (35)	17 (15)

*Variables are reported as: percent mean (standard deviation).

4.10.1 Dominant Ground Cover

As shown in **Table 4.10.1**, bare soil accounts for over one-half of ground cover on the SR_SSR sites. Together, gravel and rock account for almost 30% of the ground cover on site, while litter and basal vegetation cover only 16% of the area.

Table 4.10.1. Percent ground cover, SR SSR*.

Site Count	Soil	Gravel	Rock	Litter	Basal Veg	Wood	Other
14	54 (26)	21 (22)	7 (9)	7 (8)	9 (7)	0 (1)	0 (0)

*Cover is reported as: percent mean (standard deviation).

4.10.2 Dominant Vegetation Cover

As shown in **Table 4.10.2.1**, an average of only 16% of the SR_SSR sites is covered with native plants, while 11% is covered with exotic plant species. A majority of the exotic plant cover is contributed by weedy species. In addition, neither native forb nor native grass richness meets the standards of restoration (i.e., five plant species per life form). Native woody plants barely meets the richness standards of restoration, while covering less than 10% of the sites.

Table 4.10.2.1. Plant cover (percent) and richness (count), SR SSR*.

Variable	Forbs	Grasses	Woody	Native	Exotic = Exotic Species + Noxious Weeds	Noxious Weeds
Cover	2 (4)	6 (7)	8 (6)	16 (11)	11 (13)	9 (13)
Richness	2 (2)	1 (1)	5 (2)	9 (5)	2 (1)	2 (1)

*Variables are reported as: mean (standard deviation).

Table 4.10.2.2 shows the three species that both have the greatest cover and that are present on most SR_SSR sites. Spotted knapweed (*Centaurea maculosa*) has the greatest average canopy cover of all species present (6%), and is present on 11 SR_SSR sites. Great basin wildrye (*Leymus cinereus*) and redtop (*Agrostis stolonifera*) together account for another 8% of canopy cover, and are both present on 13 of 14 sites.

Table 4.10.2.2. Dominant plant species, SR SSR*.

Species	Percent Cover	Polygon Presence
Spotted knapweed	6 (15)	11
Great basin wildrye	5 (7)	13
Redtop	3 (4)	13

*Cover is reported as: mean (standard deviation).

The data and field notes indicate that the SR_SSR sites have a significant noxious weed infestation problem. A total of 7 noxious weed species are present, which cover an area of 25 acres spread widely across the SR_SSR polygons. This indicates that there is a significant noxious weed infestation problem on the SR_SSR sites.

4.10.3 Erosion Type

As shown in **Table 4.10.3**, most of the SR_SSR sites demonstrate significant erosion. While the types of erosion vary, erosion features are widely present across the SR_SSR sites.

Table 4.10.3. Erosion types and coverage, SR SSR*.

	Sheet	Sheet & Gully	Gully, Rill & Sheet	Wind	TOTAL
Polygon Area Demonstrating Erosion	40 (44)	85 (1)	71 (25)	80 (•)	67 (30)
Count	3	2	8	1	14

*Cover is reported as: mean (standard deviation).

• Note: no standard deviation.

4.10.4 Browse

As shown in **Table 4.10.4**, browse levels on the SR_SSR sites widely vary. Where palatable plant species occur, browse is light to heavy. Field notes indicate that, for the most part, where no browse occurred, few to any palatable plant species were present.

Table 4.10.4 Browse, SR SSR.

None (< 5 percent)	Light (5-25 percent)	Moderate (25-50 percent)	Heavy (>50 percent)
6	3	2	3

4.10.5 Microsite Availability

As shown in **Table 4.10.5**, the SR_SSR polygons show a great diversity in microsite availability. One-half of the polygons show adequate microsite availability, while one-half show moderate to inadequate microsite availability.

Table 4.10.5. Counts of microsites, SR SSR.

Adequate	Moderate	Marginal	Inadequate
7	3	1	3

4.10.6 Current and Future Conditions

As shown in **Table 4.10.6**, all of the expected dominant species are currently either absent or present in inadequate proportions on the SH_SSR sites. Conservatively and for the purpose of this analysis, a dominant species' presence is considered inadequate under existing conditions if its current cover is less than 5%, and if it is present on less than 50% of the polygons that were inventoried.

The remediation prescription for these sites calls for planting of trees and shrubs, and broadcast seeding. Given this scenario, a dominant species' future presence would be adequate if it is directly planted, or if it is included in the seed mix specified for the remedial prescription. Of the six dominant species expected on the SH_SSR sites, however, only Douglas fir (*Pseudotsuga menziesii*) and bluebunch wheatgrass (*Agropyron spicatum*) will either be planted or seeded.

Alternatively, a dominant species' future presence will be adequate if its current cover would reasonably permit the spread of this species across the polygon areas. Conservatively, this means 1% or greater current cover, and current presence on 50% or more of the polygons that were inventoried. None of the expected dominant species currently present on site, however, displays this extent of cover and distribution.

As a result and as shown in **Table 4.10.6**, future conditions under the proposed remediation scenario will result in an inadequate species composition and cover for several of the dominant species that would be expected on the SH_SSR sites. As will be discussed in **Section 6**, however,

active restoration will return a significant proportion of expected dominant and sub-dominant species, while intensive restoration will move the site most fully into a restoration trajectory.

Table 4.10.6. Dominant species composition under treatment scenarios, SR_SSR.

Desired Future Condition	Dominant Habitat Species	Current Species Data*	Existing Conditions**	Remediation Outcome	Active Restoration	Intensive Restoration
Xeric Douglas fir (16% of area)	Douglas fir	0.04% on 7%	-	+	+	+
	Pinegrass	Not Present	-	-	-	+
	Douglas fir	0.04% on 7%	-	+	+	+
	Elk sedge	Not Present	-	-	-	+
Xeric Fescue grass (84% of area)	Douglas fir	0.04% on 7%	-	+	+	+
	Bluebunch wheatgrass	0.1% on 21%	-	+	+	+
	Idaho fescue	Not Present	-	-	+	+
	Bluebunch wheatgrass	0.1% on 21%	-	+	+	+
	Rough fescue	Not Present	-	-	+	+

*Average percent cover on proportion of SR_SSR polygons.

** - inadequate cover and presence; + adequate cover and presence.

Given the restoration scenario and the challenging site conditions, BRI recommends the use enhancement planting of native species both to move the SR_SSR sites more towards a restoration trajectory and to help stabilize the significant erosion problems. The enhancement planting will augment the plantings that will occur under the remediation scenario, and will expand species diversity and provide a greater density of cover. Tree protectors should be used during planting of trees and shrubs both to provide browse protection and to augment microsite availability.

BRI's recommended remediation activities are based on the anticipation that brush boxes, dozer basins and other measures will control erosion on the slopes of the SR_SSR sites. Nonetheless, the soils of the SR_SSR sites will require amendment prior to planting. Unfortunately, the decision tree for the remediation scenario breaks out steep slope polygons before liming becomes a management option. Given the limits to ground access due to steep slopes, however, those SR_SSR polygons that show elevated trace element levels and high soil acidity should receive aerial lime application as a soil amendment under the remediation scenario. This will help neutralize acidity and reduce trace element availability, both of which would significantly improve soil conditions for plant growth and survival.

The high composition of gravel and rock will also present challenges to restoration. Such conditions, plus limits to ground access due to steep slopes, recommend the aerial application of compost, which would also improve soil conditions for plants and planting. The SR_SSR sites would also benefit from aerial seeding, both to improve ground cover and to reduce erosion. In addition, the aerial addition of fertilizer would augment conditions for growth and survival. Finally, weeds are a significant ecological challenge to restoration on the SR_SSR sites, and will require active management and monitoring.

4.11 Smelter Hill: Monitored, Well-Vegetated (SH_MWV)

BRI personnel inventoried 9 SH_MWV polygons on Smelter Hill, covering 682 of 743 SH_MWV designated, non-ARCO-owned acres on the site. Polygons range in size from 100 acres to 198 acres, with an average size of 176 acres. The elevations of these polygons range from a low of 1620 meters to a high of 2199 meters, with an average elevation of 1837 meters. The average slope is 19%. As shown in **Table 4.11**, three-fourths of the polygons' surfaces face East and North.

Table 4.11. Percentage aspect of polygons, SH_MWV*.

East	West	North	South
42 (34)	2 (6)	33 (40)	21 (26)

*Variables are reported as: percent mean (standard deviation).

4.11.1 Dominant Ground Cover

As shown in **Table 4.11.1**, bare soil accounts for one-third of ground cover on the SH_MWV sites. Together, gravel and rock account for a little over one-fourth of the ground cover on site. Litter covers a little less than one-fifth of the ground, and basal vegetation another one-fourth of the area.

Table 4.11.1. Percent ground cover, SH_MWV*.

Site Count	Soil	Gravel	Rock	Litter	Basal Veg	Wood	Other
9	33 (30)	16 (21)	10 (13)	21 (19)	24 (10)	2 (1)	0 (0)

*Cover is reported as: percent mean (standard deviation).

Together, these data indicate that the sites are generally fertile with a reasonably good substrate for plant growth.

4.11.2 Dominant Vegetation Cover and Diversity

As shown in **Table 4.11.2.1**, over one-half of the SH_MWV sites are covered with native plants and a one-fourth is covered with exotic plant species. Woody plants dominate the species richness, closely followed in richness by native forbs. Only the native grass component does not meet the standards of restoration for native species richness (i.e., five species or more per life form).

Table 4.11.2.1. Plant cover (percent) and richness (count), SH_MWV*.

Variable	Forbs	Grasses	Woody	Native	Exotic = Exotic Species + Noxious Weeds	Noxious Weeds
Cover	5 (3)	15 (14)	33 (38)	53 (32)	25 (20)	3 (4)
Richness	9 (8)	4 (2)	10 (8)	22 (15)	3 (2)	2 (1)

*Variables are reported as: mean (standard deviation).

Table 4.11.2.2 shows the three species that both have the greatest cover and that are present on most SH_MWV sites. Great basin wildrye (*Leymus cinereus*) has the greatest average canopy cover of all species present (21%), and is present on all 9 sites. Redtop (*Agrostis stolonifera*) accounts for another 18% of canopy cover and is present at 6 sites. Quaking aspen (*Populus tremuloides*) has the greatest average canopy cover of all woody species present (18%) and is present on 6 sites.

Table 4.11.2.2. Dominant plant species, SH_MWV*.

Species	Percent Cover	Polygon Presence
Redtop	21 (19)	9
Quaking aspen	18 (31)	6
Great basin wildrye	7 (9)	6

*Cover is reported as: mean (standard deviation).

This dominant species list is completely comprised of plants that are adapted both to disturbance and to elevated trace element levels. In addition, six of the seven noxious weeds found on Smelter Hill may be found in the SH_MWV polygons. These plants cover approximately nine

acres of the inventoried SH_MWV sites, a small proportion of the total acreage, but widely spread across the polygons. This indicates that there is a significant noxious weed infestation problem on the SH_MWV sites.

4.11.3 Erosion Type

As shown in **Table 4.11.3**, a majority of the SH_MWV sites demonstrate diverse, but generally widespread erosion problems. Given the steep slopes of these polygons, erosion is problematic.

Table 4.11.3. Erosion types and coverage (percent), SH_MWV*.

	None	Sheet	Sheet & Rill	Sheet & Gully	Wind	TOTAL
Polygon Area Demonstrating Erosion	0 (0)	60 (0)	25 (7)	80 (•)	89 (13)	48 (36)
Count	2	2	2	1	2	9

*Cover is reported as: mean (standard deviation).

• Note: no standard deviation.

4.11.4 Browse

As shown in **Table 4.11.4**, the SH_MWV sites display a wide range of browse conditions. In most cases, browse is light, but it is moderate to heavy on a third of the sites inventoried.

Table 4.11.4. Browse, SH_MWV.

None (< 5 percent)	Light (5-25 percent)	Moderate (25-50 percent)	Heavy (>50 percent)
1	5	1	2

4.11.5 Microsites

As shown in **Table 4.11.5**, microsite availability is mostly moderate (six polygons), but may be marginal (two) or inadequate (one). No SH_MWV showed an adequate number of microsites.

Table 4.11.5. Counts of microsites, SR SSR.

Adequate	Moderate	Marginal	Inadequate
-	6	2	1

4.11.6 Current and Future Conditions

As shown in **Table 4.11.6**, all of the expected dominant species are currently either absent or present in inadequate proportions. Conservatively and for the purpose of this analysis, a

dominant species' presence is considered inadequate under existing conditions if its current cover is less than 5%, and if it is present on less than 50% of the polygons that were inventoried.

The remediation prescription for these sites calls for little to no treatment, other than weed control efforts as necessary. Given this remediation scenario, a dominant species' future presence will be adequate if its current cover would reasonably permit the spread of this species across the polygon areas. Conservatively, this means 1% or greater current cover, and current presence on 50% or more of the polygons that were inventoried. Only bluebunch wheatgrass (*Agropyron spicatum*) is currently found at these levels of cover and presence.

As a result, future conditions under the proposed remediation scenario will result in an inadequate species composition and cover for most of the dominant species that would be expected on the SH_MWV sites. As will be discussed in Section 6, however, active restoration will return a significant proportion of expected dominant and sub-dominant species, while intensive restoration will move the site most fully into a restoration trajectory.

Table 4.11.6. Dominant species composition under treatment scenarios, SH MWV.

Desired Future Condition	Dominant Habitat Species	Current Species Data*	Existing Conditions**	Remediation Outcome	Active Restoration	Intensive Restoration
Mesic Douglas fir (10% of area)	Douglas fir	0.2% on 33%	-	-	+	+
	Huckleberry	Not Present	-	-	-	+
	Douglas fir	0.2% on 33%	-	-	+	+
	Snowberry	0.2% on 44%	-	-	+	+
Xeric Douglas fir (50% of area)	Douglas fir	0.2% on 33%	-	-	+	+
	Pinegrass	Not Present	-	-	-	+
	Douglas fir	0.2% on 33%	-	-	+	+
	Elk sedge	Not Present	-	-	-	+
	Douglas fir Bluebunch wheatgrass	0.2% on 33% 3.4% on 44%	- -	- +	+	+
Xeric Fescue grass (40% of area)	Idaho fescue	0.1% on 11%	-	-	+	+
	Bluebunch wheatgrass	3.4% on 44%	-	+	+	+
	Rough fescue	0.2% on 33%	-	-	+	+

*Average percent cover on proportion of SH_MWV polygons.

** - inadequate cover and presence; + adequate cover and presence.

Together, this information indicates that while the SH_MWV site has good foliar coverage, the species mix and cover values under either current conditions or the remediation scenario are not

what would be appropriate under a restoration scenario. This recommends the use enhancement planting of native species to achieve restoration objectives. The steep slopes and widespread erosion that is evident on site also support enhancement planting of additional native species. In addition, the moderate to inadequate browse levels on site recommend the use of tree protectors during planting, which will also augment microsite availability where it is lacking.

4.12 Stucky Ridge: Monitored, Well-Vegetated (SR_MWV)

BRI personnel inventoried 4 SR_MWV polygons on Stucky Ridge, covering 87 of 105 SR_MWV designated, non-ARCO-owned acres on the site. Polygons range in size from 10 acres to 36 acres, with an average size of 22 acres. The elevations of these polygons range from a low of 1600 meters to a high of 1809 meters, with an average elevation of 1693 meters. The average slope is 9%. As shown in **Table 4.12**, over two-thirds of the polygons' surfaces face East.

Table 4.12. Percentage aspect of polygons, SR MWV*.

East	West	North	South
68 (17)	8 (11)	15 (16)	9 (12)

*Cover is reported as: percent mean (standard deviation).

4.12.1 Dominant Ground Cover

As shown in **Table 4.12.1**, bare soil accounts for nearly one-half of ground cover on the SR_MWV sites. Litter covers a little less than one-third of the ground, and basal vegetation another one-sixth of the area. Together, gravel and rock account for less than 10% of the ground cover on site.

Table 4.12.1. Percent ground cover, SR MWV*.

Site Count	Soil	Gravel	Rock	Litter	Basal Veg	Wood	Other
4	45 (17)	9 (13)	0 (0)	28 (28)	15 (5)	1 (1)	0 (0)

*Cover is reported as: mean (standard deviation).

4.12.2 Dominant Vegetation Cover and Diversity

As shown in **Table 4.12.2.1**, one-third of the SR_MWV sites are covered with native plants and one-eighth covered with exotic plant species. Woody plants dominate the species richness, while

neither native forb nor grass richness meets the standards of restoration (i.e. five species or more per life form).

Table 4.12.2.1. Plant cover (percent) and richness (count) by polygon, SR_MWV*.

Variable	Forbs	Grasses	Woody	Native	Exotic = Exotic Species + Noxious Weeds	Noxious Weeds
Cover	4 (5)	13 (12)	13 (14)	31 (19)	12 (20)	6 (11)
Richness	3 (1)	2 (0)	7 (4)	12 (6)	3 (1)	2 (1)

*Variables are reported as: mean (standard deviation).

Table 4.12.2.2 shows the four species that both have the greatest cover and that are present on most SR_MWV sites. Great basin wildrye (*Leymus cinereus*) has the greatest average canopy cover of all species present (13%), and is present on all four sites. Wood's rose (*Rosa woodsii*) has the greatest average canopy cover of all woody species present (8%), and is present on three of four sites. Together, the exotic species redtop (*Agrostis stolonifera*) and hoary pepperwort (*Cardaria draba*) account for 9% of canopy cover, and are present, respectively on three and four of the inventoried SR_MWV sites.

Table 4.12.2.2. Dominant plant species, SR_MWV*.

Species	Percent Cover	Polygon Presence
Great basin wildrye	13 (12)	4
Wood's rose	8 (9)	3
Hoary pepperwort	5 (10)	3
Redtop	4 (4)	4

*Cover is reported as: mean (standard deviation).

This dominant species list is completely comprised of plants that are adapted both to disturbance and to elevated trace element levels. In addition, the noxious weeds hoary pepperwort (*Cardaria draba*) and leafy spurge (*Euphorbia esula*) cover approximately nine acres, spread widely across three of the four the SR_MWV sites. This indicates that there is a significant noxious weed infestation problem on the SR_MWV sites.

4.12.3 Erosion Type

As shown in **Table 4.12.3**, most of the SR_MWV sites demonstrate diverse, but widespread erosion problems. Additionally, two of the four sites show signs of active, off-road-vehicle use.

Table 4.12.3. Erosion types and coverage (percent), SR_MWV*.

	None	Sheet & Rill	Gully	Gully, Rill & Sheet	TOTAL
Polygon Area Demonstrating Erosion	0 (•)	90 (•)	70 (•)	80 (•)	60 (41)
Count	1	1	1	1	4

*Cover is reported as: mean (standard deviation).

• Note: no standard deviation.

4.12.4 Browse

As shown in **Table 4.12.4**, one SR_MWV site shows light browse, three show moderate browse.

Table 4.12.4. Browse, SR_MWV.

None (< 5 percent)	Light (5-25 percent)	Moderate (25-50 percent)	Heavy (>50 percent)
-	1	3	-

4.12.5 Microsite Availability

As shown in **Table 4.12.5**, microsite availability is highly variable on the SR_MWV sites, ranging from inadequate to adequate.

Table 4.12.5. Counts of microsites, SR_MWV.

Adequate	Moderate	Marginal	Inadequate
1	1	1	1

4.12.6 Current and Future Conditions

As shown in **Table 4.12.6**, all of the expected dominant species are currently either absent or present in inadequate proportions. Conservatively and for the purpose of this analysis, a dominant species' presence is considered inadequate under existing conditions if its current cover is less than 5%, and if it is present on less than 50% of the polygons that were inventoried.

The remediation prescription for these sites calls for little to no treatment, other than weed control efforts as necessary. Given this remediation scenario, a dominant species' future presence

will be adequate if its current cover will reasonably permit the spread of this species across the polygon areas. Conservatively and for the purpose of this analysis, this means 1% or greater current cover, and current presence on 50% or more of the polygons that were inventoried. None of the expected dominant species are currently found at these levels of cover or presence.

As a result and as shown in **Table 4.12.6**, future conditions under the proposed remediation scenario will result in an inadequate species composition and cover for most of the dominant species that would be expected on the SR_MWV sites. As will be discussed in **Section 6**, however, active restoration will return a significant proportion of expected dominant and sub-dominant species, while intensive restoration will move the site most fully into a restoration trajectory.

Table 4.12.6. Dominant species composition under treatment scenarios, SR_MWV.

Desired Future Condition	Dominant Habitat Species	Current Species Data*	Existing Conditions**	Remediation Outcome	Active Restoration	Intensive Restoration
Mesic Douglas fir (2% of area)	Douglas fir	Not Present	-	-	+	+
	Huckleberry	Not Present	-	-	-	+
	Douglas fir Snowberry	Not Present 0.1% on 25%	- -	- -	+ +	+ +
Xeric Douglas fir (42% of area)	Douglas fir	Not Present	-	-	+	+
	Pinegrass	Not Present	-	-	-	+
	Douglas fir Elk sedge	Not Present Not Present	- -	- -	+ -	+ +
	Douglas fir Bluebunch wheatgrass	Not Present 0.1% on 25%	- -	- -	+ +	+ +
Xeric Fescue grass (53% of area)	Idaho fescue	Not Present	-	-	+	+
	Bluebunch wheatgrass	0.1% on 25%	-	-	+	+
	Rough fescue	Not Present	-	-	+	+

*Average percent cover on proportion of SR_MWV polygons.

** - inadequate cover and presence; + adequate cover and presence.

Given the restoration scenario and existing site conditions, BRI recommends the use enhancement planting of native species both to move the SR_MWV sites more towards a restoration trajectory and to help stabilize erosion problems. To this end, the enhancement of microsite availability on several of the SR_MWV polygons will be required. This dearth of microsites and the moderate levels of browse noted on most sites will be best met with the use of tree protectors. Further, significant noxious weed control will be required across the SR_MWV

sites. Finally, the significant signs of off-road vehicle use on one-half the SR_MWV sites suggests that humans use of the sites will have to be monitored and managed as site restoration is implemented.

4.13 Smelter Hill: Well-Vegetated (SH_WV)

BRI personnel inventoried 3 SH_WV polygons on Smelter Hill, covering 107 of 111 SH_WV designated, non-ARCO-owned acres on the site. Polygons range in size from 32 acres to 42 acres, with an average size of 36 acres. The elevations of these polygons range from a low of 1650 meters to a high of 1889 meters, with an average elevation of 1755 meters. The average slope is 11%. As shown in Table 4.13, the polygon's surfaces face every point of the compass, but most face East and the fewest face West.

Table 4.13. Percentage aspect of polygons, SH_WV*.

East	West	North	South
44 (15)	9 (15)	25 (23)	22 (23)

*Variables are reported as: percent mean (standard deviation).

4.13.1 Dominant Ground Cover

As shown in Table 4.13.1, bare soil accounts for a little over one-fourth of ground cover on the SH_WV sites. Gravel and rock are a minor component of the site. Litter and basal vegetation cover, however, are major components, covering nearly three-fourths of the ground.

Table 4.13.1. Percent ground cover, SH_WV*.

Site Count	Soil	Gravel	Rock	Litter	Basal Veg	Wood	Other
3	27 (38)	0 (0)	0 (0)	33 (12)	40 (20)	4 (5)	0 (0)

*Cover is reported as: mean (standard deviation).

4.13.2 Dominant Vegetation Cover

As shown in Table 4.13.2.1, well over four-fifths of the SH_WV sites is covered with native plants, with the remainder covered with exotic plant species. Both native woody plants and forb meet the per polygon richness standards for restoration (i.e., at least five species per life form), and grass diversity nearly meets this standard.

Table 4.13.2.1. Plant cover (percentage) and richness (count), SH_WV*.

Variable	Forbs	Grasses	Woody	Native	Exotic = Exotic species + Noxious Weeds	Noxious Weeds
Cover	7 (5)	18 (23)	62 (50)	87 (29)	23 (8)	3 (3)
Richness	7 (2)	4 (4)	9 (1)	21 (4)	3 (2)	2 (0)

*Variables are reported as: mean (standard deviation).

Table 4.13.2.2 shows the four species that both have the greatest cover and that are present on most SH_WV sites. Quaking aspen (*Populus tremuloides*) has the greatest average canopy cover of all woody species present (34%), and is present on all 3 sites. Redtop (*Agrostis stolonifera*) accounts for another 20% of canopy cover, with Great basin wildrye (*Leymus cinereus*) accounting for another 5%. Oregongrape (*Berberis repens*) and common snowberry (*Symphoricarpos albus*) respectively contribute another ten and 5% cover.

Table 4.13.2.2. Dominant plant species, SH_WV*.

Species	Percent Cover	Polygon Presence
Quaking aspen	34 (49)	3
Redtop	20 (10)	3
Oregongrape	10 (10)	3
Great basin wildrye	5 (5)	3
Common snowberry	5 (5)	3

*Cover is reported as: mean (standard deviation).

Field reconnaissance indicates that most of the SH_WV polygon areas are well vegetated with a strong mix of species. With the exception of very selective spots that may require weed control, these areas seem to be on a trajectory towards remediation. Nonetheless, the dominant species list for the SH_WV polygon areas is completely comprised of plants that are adapted both to disturbance and to elevated trace element levels.

4.13.3 Erosion Type

As shown in **Table 4.13.3**, two of the three SH_WV sites demonstrate little to no erosion. One site, however, shows sheet erosion across a broad area of the polygon.

Table 4.13.3. Erosion types and coverage (percent), SH_WV*.

	None	Sheet	Sheet & Rill	TOTAL
Polygon Area Demonstrating Erosion	0 (•)	70 (•)	0.5 (•)	24 (40)
Count	1	1	1	3

*Cover is reported as: mean (standard deviation).

• Note: no standard deviation.

4.13.4 Browse

Table 4.13.4. shows that browse on the SH_WV sites is light to moderate.

Table 4.13.4 Browse, SH WV.

None (< 5 percent)	Light (5-25 percent)	Moderate (25-50 percent)	Heavy (>50 percent)
-	1	2	-

4.13.5 Microsite Availability

Table 4.13.5 shows that two of the SH_WV polygons have a moderate number of microsites; one has an inadequate number.

Table 4.13.5. Counts of microsites, SH WV.

Adequate	Moderate	Marginal	Inadequate
-	2	-	1

4.13.6 Current and Future Conditions

As shown in Table 4.13.6, all of the expected dominant species are currently either absent or present in inadequate proportions on the SH_WV sites. Conservatively and for the purpose of this analysis, a dominant species' presence is considered inadequate under existing conditions if its current cover is less than 5%, and if it is present on less than 50% of the polygons that were inventoried.

The remediation prescription for these sites calls for little to no treatment, other than weed control efforts as necessary. Given this remediation scenario, a dominant species' future presence will be adequate if its current cover will reasonably permit the spread of this species across the polygon areas. Conservatively and for the purpose of this analysis, this means 1% or greater current cover, and current presence on 50% or more of the polygons that were inventoried. Only common snowberry (*Symphoricarpos albus*) is currently found at these levels of cover or presence.

As a result and as shown in **Table 4.13.6**, future conditions under the proposed remediation scenario will result in an inadequate species composition and cover for most of the dominant species that would be expected on the SH_WV sites. As will be discussed in **Section 6**, however, active restoration will return a significant proportion of expected dominant and sub-dominant species, while intensive restoration will move the site most fully into a restoration trajectory.

Table 4.13.6. Dominant species composition under treatment scenarios, SH_WV.

Desired Future Condition	Dominant Habitat Species	Current Species Data*	Existing Conditions**	Remediation Outcome	Active Restoration	Intensive Restoration
Mesic Douglas fir (18% of area)	Douglas fir	0.2% on 33%	-	-	+	+
	Huckleberry	Not Present	-	-	-	+
	Douglas fir Snowberry	0.2% on 33% 4.5% on 100%	- -	- +	++ +	++ +
Xeric Douglas fir (31% of area)	Douglas fir	0.2% on 33%	-	-	+	+
	Pinegrass	Not Present	-	-	-	+
	Douglas fir Elk sedge	0.2% on 33% Not Present	- -	- -	++ -	++ +
	Douglas fir Bluebunch wheatgrass	0.2% on 33% Not Present	- -	- -	++ +	++ +
Xeric Fescue grass (50% of area)	Idaho fescue	Not Present	-	-	+	+
	Bluebunch wheatgrass	Not Present	-	-	+	+
	Rough fescue	Not Present	-	-	+	+

*Average percent cover on proportion of SH_WV polygons.

** - inadequate cover and presence; + adequate cover and presence.

Given the restoration scenario and existing site conditions, BRI recommends the use enhancement planting of native species both to move the SH_WV sites more towards a restoration trajectory and to help stabilize erosion problems. Given the dearth of microsites and the preponderance of sites with moderate browse conditions, tree projectors also should be used to augment areas that lack microsites and to provide browse protection.

4.14 Stucky Ridge: Well-Vegetated (SR_WV)

BRI personnel inventoried 9 SR_WV polygons on Stucky Ridge, covering 227 of 274 SR_WV designated, non-ARCO-owned acres on the site. Polygons range in size from 5 acres to 69 acres, with an average size of 25 acres. The elevations of these polygons range from a low of 1540 meters to a high of 1839 meters, with an average elevation of 1683 meters. The average slope is 13%. As shown in **Table 4.14**, a majority of the polygons' surfaces face South and East.

Table 4.14. Percentage aspect of polygons, SR_WV*.

East	West	North	South
36 (37)	13 (20)	2 (4)	49 (36)

*Variables are reported as: percent mean (standard deviation).

4.14.1 Dominant Ground Cover

As shown in **Table 4.14.1**, bare soil accounts for nearly one third of ground cover on the SR_WV sites. Litter also covers a little less than one-third of the ground, and basal vegetation another one-fourth of the area. Together, gravel and rock account for a little more than 10% of the ground cover on site.

Table 4.14.1. Percent ground cover, SR_WV*.

Site Count	Soil	Gravel	Rock	Litter	Basal Veg	Wood	Other
9	27 (16)	10 (11)	3 (4)	29 (18)	24 (18)	3 (3)	0 (0)

*Variables are reported as: percent mean (standard deviation)

4.14.2 Dominant Vegetation Cover

As shown in **Table 4.14.2.1**, nearly one-half of the SR_WV sites is covered with native plants and one-fifth is covered with exotic plant species. Woody plants dominate the species richness, while neither native forb nor native grass richness meets the standards of restoration (i.e., five or more species per life form).

Table 4.14.2.1. Plant cover (percent) and richness (count), SR_WV*.

Variable	Forbs	Grasses	Woody	Native	Exotic = Exotic Species + Noxious Weeds	Noxious Weeds
Cover	4 (6)	12 (11)	31 (33)	47 (31)	21 (31)	3 (4)
Richness	2 (2)	3 (2)	7 (3)	13 (6)	3 (2)	1 (1)

*Variables are reported as: mean (standard deviation).

Table 4.14.2.2 shows the four species that both have the greatest cover and that are present on most SR_WV sites. Great basin wildrye (*Leymus cinereus*) has the greatest average canopy cover of all species present (10%), and is present on eight of nine sites. Redtop (*Agrostis stolonifera*) accounts for another 6% of canopy cover and is present at seven of nine sites. Wood's rose (*Rosa woodsii*) and quaking aspen (*Populus tremuloides*) have the greatest average canopy cover of all woody species present (6% each), although Wood's rose is present on six of nine sites, while quaking aspen is present on only four of nine sites.

Table 4.14.2.2. Dominant plant species, SR_WV*.

Species	Percent Cover	Polygon Presence
Great basin wildrye	10 (10)	8
Redtop	6 (6)	7
Wood's rose	6 (13)	6
Quaking aspen	6 (11)	4

*Cover is reported as: mean (standard deviation).

Field reconnaissance indicates that some of the SR_WV polygon areas, in particular lower elevation, wet zones, are heavily vegetated with a good mix of native species. With the exception of spots that will require weed control, these areas seem to be on a trajectory towards remediation. Nonetheless, the dominant species list for the SR_WV polygon areas is completely comprised of plants that are adapted both to disturbance and to elevated trace element levels. In addition, the noxious weeds, hoary pepperwort (*Cardaria draba*) and leafy spurge (*Euphorbia esula*), cover approximately six acres of the SR_WV sites, spread widely across one-third of the SR_WV polygons. This indicates that there is a significant noxious weed infestation problem on several of the SR_WV sites.

4.14.3 Erosion Type

As shown in **Table 4.14.3**, most of the SR_WV sites demonstrate diverse, but generally moderate erosion problems. One third of the sites, however, have combined gully, rill and sheet erosion across an average one-half of their polygons.

Table 4.14.3. Erosion types and coverage (percent), SR_WV.

	None	Sheet	Sheet & Rill	Sheet & Gully	Gully, Rill & Sheet	TOTAL
Polygon Area Demonstrating Erosion	0 (•)	21 (25)	20 (•)	20 (•)	50 (10)	28 (22)
Count	1	3	1	1	3	9

*Cover is reported as: percent mean (standard deviation).

• Note: no standard deviation.

4.14.4 Browse

As shown in **Table 4.14.4**, browse levels are highly variable across the SR_WV sites. Nonetheless, more than one-half of the polygons show moderate to heavy browse.

Table 4.14.4. Browse, SR_WV.

None (< 5 percent)	Light (5-25 percent)	Moderate (25-50 percent)	Heavy (>50 percent)
2	2	2	3

4.14.5 Microsite Availability

As shown in **Table 4.14.5**, polygons have moderate numbers of microsites, but a majority (five) of the SR_WV polygons have adequate microsite availability. Only one of the SR_WV polygons has inadequate numbers of microsites.

Table 4.14.5. Counts of Microsites, SR_WV.

Adequate	Moderate	Marginal	Inadequate
5	3	-	1

4.14.6 Current and Future Conditions

As shown in **Table 4.14.6**, most of the expected dominant species are currently either absent or present in inadequate proportions on the SR_WV sites. Conservatively and for the purpose of this analysis, a dominant species' presence is considered inadequate under existing conditions if its current cover is less than 5%, and if it is present on less than 50% of the polygons that were

inventoried. Under these criteria, only Douglas fir (*Pseudotsuga menziesii*) is present in adequate quantities on the SR_WV sites.

The remediation prescription for these sites calls for little to no treatment, other than weed control efforts as necessary. Given this remediation scenario, a dominant species' future presence will be adequate if its current cover will reasonably permit the spread of this species across the polygon areas. Conservatively and for the purpose of this analysis, this means 1% or greater current cover, and current presence on 50% or more of the polygons that were inventoried. Again, only Douglas fir (*Pseudotsuga menziesii*) is found at these levels of cover or presence.

As a result and as shown in Table 4.14.6, future conditions under the proposed remediation scenario will result in an inadequate species composition and cover for most of the dominant species that would be expected on the SR_WV sites. As will be discussed in Section 6, however, active restoration will return a significant proportion of expected dominant and sub-dominant species, while intensive restoration will move the site most fully into a restoration trajectory.

Table 4.14.6. Dominant species composition under treatment scenarios, SR_WV.

Desired Future Condition	Dominant Habitat Species	Current Species Data*	Existing Conditions**	Remediation Outcome	Active Restoration	Intensive Restoration
Mesic Douglas fir (6% of area)	Douglas fir	7.8% on 22%	-	-	+	+
	Huckleberry	Not Present	-	-	-	+
	Douglas fir Snowberry	7.8% on 22% 0.2% on 33%	- -	- -	+ +	+ +
Xeric Douglas fir (25% of area)	Douglas fir	7.8% on 22%	-	-	+	+
	Pinegrass	Not Present	-	-	-	+
	Douglas fir Elk sedge	7.8% on 22% Not Present	- -	- -	+ -	+ +
	Douglas fir Bluebunch wheatgrass	7.8% on 22% 0.1% on 22%	- -	- -	+ +	+ +
Xeric Fescue grass (55% of area)	Idaho fescue	Not Present	-	-	+	+
	Bluebunch wheatgrass	0.1% on 22%	-	-	+	+
	Rough fescue	Not Present	-	-	+	+

*Average percent cover on proportion of SR_WV polygons.

** - inadequate cover and presence; + adequate cover and presence.

Given the restoration scenario and existing site conditions, BRI recommends the use enhancement planting of native species both to move the SR_WV sites more towards a

restoration trajectory and to help stabilize erosion problems. To this end, the enhancement of microsite availability on several of the SR_WV polygons will be required. This dearth of microsites and the moderate to heavy levels of browse noted on most sites will be best met with the use of tree protectors. Further, significant noxious weed control will be required on several of the SR_WV sites.

4.15 Smelter Hill: Previously Reclaimed (SH_PR)

BRI personnel inventoried one SH_PR polygon on Smelter Hill. This polygon is 14 acres in size and ranges from 1620 to 1769 meters in elevation. The average slope is 14%. As shown in **Table 4.15**, a majority of the polygon's surfaces face North.

Table 4.15. Percentage aspect of polygons, SH PR*.

East	West	North	South
10 (•)	10 (•)	80 (•)	0 (•)

*Variables are reported as: percent mean (standard deviation).

• Note: no standard deviation.

4.15.1 Dominant Ground Cover

As shown in **Table 4.15.1**, gravel accounts for one-half of the ground cover, with rock and bare soil accounts each adding one-tenth to ground. Basal vegetation and litter respectively contribute another 10% and 20% cover.

Table 4.15.1. Percent ground cover, SH PR*.

Site Count	Soil	Gravel	Rock	Litter	Basal Veg	Wood	Other
2	10 (•)	50 (•)	10 (•)	20 (•)	10 (•)	1 (•)	0 (•)

*Cover is reported as: percent mean (standard deviation).

• Note: no standard deviation.

4.15.2 Dominant Vegetation Cover

As shown in **Table 4.15.2.1**, just over 30% of the SH_PR sites is covered with native plants, but over 40% is covered with exotic plant species. Both native woody species and forb species meet the numerical richness standards for restoration (i.e., five species or more per life form); native grass species do not. Weedy species cover are not richly present and cover much less than 1 of the 14 acres.

Table 4.15.2.1. Plant cover (percent) and richness (count), SH_PR.

Variable	Forbs	Grasses	Woody	Native	Exotic = Exotic species + Noxious weeds	Noxious Weeds
Cover	5 (•)	11 (•)	16 (•)	31 (•)	43 (•)	4 (•)
Richness	9 (•)	2 (•)	8 (•)	19 (•)	3 (•)	2 (•)

*Variables are reported as: mean (standard deviation).

• Note: no standard deviation.

Table 4.15.2.2 shows the four species that both have the greatest cover and that are present on most SH_PR sites. Redtop (*Agrostis stolonifera*) has the greatest presence on site followed by Great basin wildrye (*Leymus cinerus*). Douglas fir (*Pseudotsuga menziesii*) has a strong foothold on the site; spotted knapweed (*Centaurea maculosa*) is present on site.

Table 4.15.2.2. Dominant Plant Species, SH_PR*.

Species	Percent Cover
Redtop	40
Great basin wildrye	10
Douglas fir	10
Spotted knapweed	3

*Cover is reported as: mean.

Data from the SH_PR sites shows that overall plant cover is very good. Nonetheless, the strong presence of exotic plants suggests that the species mix is not what would be desired under a restoration scenario. Overall, however, this site shows a good diversity of species and good plant cover. Microsites are moderately availability on the polygon, indicating good niche availability. The heavy browse level observed, however, suggests that this site should continue to be monitored as remediation progresses.

4.15.3 Erosion Type

As shown in **Table 4.15.3**, the SH_PR site does not show significant erosion, due probably to the strong plant cover.

Table 4.15.3. Erosion types and coverage, SH PR*.

	None	TOTAL
Polygon Area Demonstrating Erosion	0 (*)	0 (*)
Count	1	1

*Variables are reported as: percent mean (standard deviation).

• Note: no standard deviation.

4.15.4 Current and Future Conditions

As shown in **Table 4.15.4**, most of the expected dominant species are currently either absent or present in inadequate proportions. Conservatively and for the purpose of this analysis, a dominant species' presence is considered inadequate under existing conditions if its current cover is less than 5%, and if it is present on less than 50% of the polygons that were inventoried. Currently, only Douglas fir (*Pseudotsuga menziesii*) meets these criteria.

The remediation prescription for these sites calls for little to no treatment, other than weed control efforts as necessary. Given this remediation scenario, a dominant species' future presence will be adequate if its current cover would reasonably permit the spread of this species across the polygon areas. Conservatively, this means 1% or greater current cover, and current presence on 50% or more of the polygons that were inventoried. Again, only Douglas fir meets these criteria.

As a result, future conditions under the proposed remediation scenario will result in an inadequate species composition and cover for most of the dominant species that would be expected on the SH_PR sites. As will be discussed in **Section 6**, however, active restoration will return a significant proportion of expected dominant and sub-dominant species, while intensive restoration will move the site most fully into a restoration trajectory.

Given the restoration scenario and existing site conditions, BRI recommends the use enhancement planting of native species both to move the SH_PR sites more towards a restoration trajectory and to add appropriate native species diversity. In particular, native grass species richness should be augmented. In addition, tree protectors must be utilized to protect enhancement plantings from browse.

Table 4.15.4. Dominant species composition under treatment scenarios, SH_PR.

Desired Future Condition	Dominant Habitat Species	Current Species Data*	Existing Conditions**	Remediation Outcome	Active Restoration	Intensive Restoration
Mesic Douglas fir (24% of area)	Douglas fir	10% on 100%	+	+	+	+
	Huckleberry	Not Present	-	-	-	+
	Douglas fir	10% on 100%	+	+	+	+
	Snowberry	Not Present	-	-	+	+
Xeric Douglas fir (17% of area)	Douglas fir	10% on 100%	+	+	+	+
	Pinegrass	Not Present	-	-	-	+
	Douglas fir	10% on 100%	+	+	+	+
	Elk sedge	Not Present	-	-	-	+
	Douglas fir Bluebunch wheatgrass	10% on 100% Not Present	+	+	+	+
Xeric Fescue grass (14% of area)	Idaho fescue	Not Present	-	-	+	+
	Bluebunch wheatgrass	Not Present	-	+	+	+
	Rough fescue	Not Present	-	-	+	+
Mesic Fescue grass (17% of area)	Idaho fescue	Not Present	-	-	+	+
	Rough fescue	Not Present	-	-	+	+
Lodgepole pine (2% of area)	Lodgepole pine	0.5% on 100%	-	-	+	+
	Twinflower	Not Present	-	-	-	+
	Lodgepole pine	0.5% on 100%	-	-	+	+
	Grouse whortleberry	Not Present	-	-	-	+
	Lodgepole pine	0.5% on 100%	-	-	+	+
Lodgepole pine/ Douglas fir (3% of area)	Pinegrass	Not Present	-	-	-	+
	Lodgepole pine	0.5% on 100%	-	-	+	+
	Douglas fir	10% on 100%	+	+	+	+
	Twinflower	Not Present	-	-	-	+
	Lodgepole pine	0.5% on 100%	-	-	+	+
	Douglas fir	10% on 100%	+	+	+	+
	Grouse whortleberry	Not Present	-	-	-	+
	Lodgepole pine	0.5% on 100%	-	-	+	+
Subalpine fir (22% of area)	Douglas fir	10% on 100%	+	+	+	+
	Pinegrass	Not Present	-	-	-	+
	Subalpine fir	Not Present	-	-	+	+
	Beargrass	Not Present	-	-	-	+
	Subalpine fir	Not Present	-	-	+	+
	Grouse whortleberry	Not Present	-	-	-	+
	Subalpine	Not Present	-	-	+	+
	Pinegrass	Not Present	-	-	-	+

*Average percent cover on proportion of SH_PR polygons.

** - inadequate cover and presence; + adequate cover and presence.

4.16 Stucky Ridge: Previously Reclaimed (SR_PR)

BRI personnel inventoried 2 SR_PR polygons on Stucky Ridge, covering 84 of 123 SR_PR designated, non-ARCO-owned acres on the site. Polygons ranged in size from 20 acres to 65 acres, with an average size of 42 acres. The elevations of these polygons range from a low of 1570 meters to a high of 1779 meters, with an average elevation of 1667 meters. The average slope is 7%. As shown in Table 4.16, a majority of the polygons' surfaces face South, with one-fourth facing East.

Table 4.16. Percentage aspect of polygons, SR_PR*.

East	West	North	South
25 (34)	12 (15)	2 (2)	61 (21)

*Variables are reported as: percent mean (standard deviation).

4.16.1 Dominant Ground Cover

As shown in Table 4.16.1, bare soil accounts for one-fifth of ground cover on the SR_PR sites, with gravel covering one-tenth. Basal vegetation and litter each covers over one-third of the sites.

Table 4.16.1. Ground cover, SR_PR*.

Site Count	Soil	Gravel	Rock	Litter	Basal Veg	Wood	Other
2	20 (14)	10 (13)	0 (0)	35 (21)	35 (7)	0 (0)	0 (0)

*Cover is reported as: percent mean (standard deviation).

4.16.2 Dominant Vegetation Cover

As shown in Table 4.16.2.1, just under one-third of the SR_PR sites is covered with native plants and over one-third is covered with exotic plant species. None of the native life forms meet the standards of restoration for species richness (i.e., five species or more per life form).

Table 4.16.2.1. Plant cover (percent) and richness (count), SR_PR*.

Variable	Forbs	Grasses	Woody	Native	Exotic = Exotic Species + Noxious Weeds	Noxious Weeds
Cover	0.3 (0.4)	30 (10)	1 (1)	31 (11)	37 (14)	4(0)
Richness	0.5 (0.7)	4 (2)	2 (2)	6 (5)	3 (1)	2 (0)

*Variables are reported as: mean (standard deviation).

Table 4.16.2.2 shows the four species that both have the greatest cover and that are present on most SR_PR sites. Great basin wildrye (*Leymus cinereus*) has the greatest average canopy cover of all species present (25%), and is present on both sites. Crested wheatgrass (*Agropyron cristatum*) follows in cover, then redtop (*Agrostis stolonifera*), and then Sandberg's bluegrass (*Poa sandbergii*). All four grass species are present on both SR_PR sites.

Table 4.16.2.2. Dominant plant species, SR PR* .

Species	Percent Cover	Polygon Presence
Great basin wildrye	25 (23)	2
Crested wheatgrass	22 (31)	2
Redtop	10 (5)	2
Sandberg's bluegrass	3 (3)	2

*Cover is reported as: mean (standard deviation).

Data from the SR_PR sites shows that overall plant cover is very good. Nonetheless, one-third of the species are exotic, therefore even with the strong cover values, the species mix is not what would be appropriate under a restoration scenario.

4.16.3 Erosion Type

As shown in Table 4.16, the SR_PR sites do not show significant erosion problems. This is probably due to the strong plant cover present on site.

Table 4.16.3 Erosion types and coverage, SR PR*.

	None	Sheet	TOTAL
Polygon Area Demonstrating Erosion	0 (•)	3 (•)	2 (2)
Count	1	1	2

*Cover is reported as: percent mean (standard deviation).

• Note: no standard deviation.

4.16.4 Browse

As shown in Table 4.16.4, one of the polygons show moderate browse levels, the other no browse levels. The site without browse, however, shows no browse because no palatable shrub species are present on the site.

Table 4.16.4. Browse, SR PR.

None (< 5 percent)	Light (5-25 percent)	Moderate (25-50 percent)	Heavy (>50 percent)
1	-	1	-

4.16.5 Microsite Availability

As shown in **Table 4.16.5**, one of the SR_PR polygons showed an adequate number of microsites; the other showed an inadequate number of microsites due to the fact that the site has been groomed during the course of reclamation.

Table 4.16.5 Counts of microsites, SR PR.

Adequate	Moderate	Marginal	Inadequate
1	-	-	1

4.16.6 Current and Future Conditions

As shown in **Table 4.16.6**, all of the expected dominant species are currently either absent or present in inadequate proportions on the SR_PR sites. Conservatively and for the purpose of this analysis, a dominant species' presence is considered inadequate under existing conditions if its current cover is less than 5%, and if it is present on less than 50% of the polygons that were inventoried.

The remediation prescription for these sites calls for little to no treatment, other than weed control efforts as necessary. Given this remediation scenario, a dominant species' future presence will be adequate if its current cover will reasonably permit the spread of this species across the polygon areas. Conservatively and for the purpose of this analysis, this means 1% or greater current cover, and current presence on 50% or more of the polygons that were inventoried. Only bluebunch wheatgrass (*Agropyron spicatum*) is currently found at these levels of cover or presence.

As a result and as shown in **Table 4.16.6**, future conditions under the proposed remediation scenario will result in an inadequate species composition and cover for most of the dominant species that would be expected on the SR_PR sites. As will be discussed in **Section 6**, however, active restoration will return a significant proportion of expected dominant and sub-dominant species, while intensive restoration will move the site most fully into a restoration trajectory.

Table 4.16.6. Dominant species composition under treatment scenarios, SR_PR.

Desired Future Condition	Dominant Habitat Species	Current Species Data*	Existing Conditions**	Remediation Outcome	Active Restoration	Intensive Restoration
Mesic Douglas fir (5% of area)	Douglas fir	Not Present	-	-	+	+
	Huckleberry	Not Present	-	-	-	+
	Douglas fir	Not Present	-	-	+	+
	Snowberry	Not Present	-	-	+	+
Xeric Douglas fir (38% of area)	Douglas fir	Not Present	-	-	+	+
	Pinegrass	Not Present	-	-	-	+
	Douglas fir	Not Present	-	-	+	+
	Elk sedge	Not Present	-	-	-	+
	Douglas fir Bluebunch wheatgrass	Not Present 1.5% on 50%	- -	- +	+ +	+ +
Xeric Fescue grass (56% of area)	Idaho fescue	Not Present	-	-	+	+
	Bluebunch wheatgrass	1.5% on 50%	-	+	+	+
	Rough fescue	Not Present	-	-	+	+

*Average percent cover on proportion of SR_PR polygons.

** - inadequate cover and presence; + adequate cover and presence.

Given the restoration scenario and existing site conditions, BRI recommends the use enhancement planting of native species both to move the SR_PR sites more towards a restoration trajectory and to add to appropriate native species diversity. To this end, the enhancement of microsite availability on the SR_PR polygons will be required. The dearth of microsites and the variable levels of browse noted will be best met with the use of tree protectors.

4.17 Smelter Hill: No Action - Rock (SH_NA-R)

BRI personnel inventoried 2 SH_NA-R polygons on Smelter Hill, covering 12 of 12 SH_NA-R designated, non-ARCO-owned acres on the site. Polygons range in size from four acres to eight acres, with an average size of six acres. The elevations of these polygons ranged from a low of 1590 meters to a high of 1799 meters, with an average elevation of 1687 meters. The average slope is 14%. As shown in Table 4.17, a majority of the polygons' surfaces face North.

Table 4.17. Percentage aspect of polygons, SH NA-R*.

East	West	North	South
19 (27)	16 (22)	58 (7)	8 (11)

*Variables are reported as: percent mean (standard deviation).

4.17.1 Dominant Ground Cover

As shown in **Table 4.17.1**, bare soil accounts for less than one-tenth of ground cover on the SH_NA-R sites. Gravel and rock cover another 60% of the sites. Surprisingly, in comparison to the SR_NA-R sites, basal vegetation and litter account are strongly present, accounting for over 35% of ground cover.

Table 4.17.1. Percent ground cover, SH NA-R*.

Site Count	Soil	Gravel	Rock	Litter	Basal Veg	Wood	Other
2	7 (5)	15 (7)	45 (35)	17 (19)	25 (7)	0 (0)	0 (0)

*Cover is reported as: percent mean (standard deviation).

4.17.2 Dominant Vegetation Cover

As shown in **Table 4.17.2** and unlike SR_NA-R sites, plants are well established on the SH_NA-R sites. Native plants cover roughly one-third of the sites; exotic plants just over another one-fourth of the sites. Woody plants predominate species richness and indeed meet the requirements of restoration (i.e., five species or more per life form). The number of native grasses and forbs, however, does not meet these requirements.

Table 4.17.2. Plant cover (percent) and richness (count), SH NA-R*.

Variable	Forbs	Grasses	Woody	Native	Exotic = Exotic Species + Noxious Weeds	Noxious Weeds
Cover	3 (3)	10 (0)	18 (3)	30 (6)	27 (24)	5 (7)
Richness	3 (2)	1 (0)	9 (2)	12 (4)	5 (1)	1 (0)

*Variables are reported as: mean (standard deviation).

The strong cover of plant species suggests that opportunities for plant growth on rocky sites are not necessarily limited by geologic patterns. A review of the individual species data, however, shows that the two SH_NA-R sites are very different in dominant plant species. One is dominated by redtop and Koeler's grass, the other by spotted knapweed, Great basin wildrye and wax currant. Both sites, however, show a presence of Wood's rose, chokecherry, and serviceberry, all of which are important wildlife browse.

4.17.3 Erosion Type

As shown in **Table 4.17.3**, the two SH_NA-R sites show no erosion.

Table 4.17.3. Erosion types and coverage, SH NA-R*.

	None	TOTAL
Polygon Area Demonstrating Erosion	0 (0)	0 (0)
Count	2	2

*Cover is reported as: percent mean (standard deviation).

4.17.4 Browse

As shown in **Table 4.17.4**, the SH_NA-R sites show moderate to heavy browse. This indicates that the rockiness of the sites does not counter their importance as niches for wildlife grazing.

Table 4.17.4. Browse, SH NA-R.

None (< 5 percent)	Light (5-25 percent)	Moderate (25-50 percent)	Heavy (>50 percent)
-	-	1	1

*Variables are reported as: mean (standard deviation).

4.17.5 Microsite Availability

As shown in **Table 4.17.5**, there is a dearth of microsites on the SR_NA-R sites. As a result, the inherent rockiness of such sites, and the presence of plants in most niches generally obviate the need for planting on this site.

Table 4.17.5. Counts of microsites, SH NA-R.

Adequate	Moderate	Marginal	Inadequate
-	-	-	2

4.17.6 Current and Future Conditions

As shown in **Table 4.17.6**, all of the expected dominant species are currently either absent or present in inadequate proportions on the SH_NA-R sites. Conservatively and for the purpose of this analysis, a dominant species' presence is considered inadequate under existing conditions if its current cover is less than 5%, and if it is present on less than 50% of the polygons that were inventoried.

The remediation prescription for these sites calls for little to no treatment, other than weed control efforts as necessary. Given this remediation scenario, a dominant species' future presence will be adequate if its current cover will reasonably permit the spread of this species across the polygon areas. Conservatively and for the purpose of this analysis, this means 1% or greater current cover, and current presence on 50% or more of the polygons that were inventoried. Only Douglas fir (*Pseudotsuga menziesii*) and rough fescue (*Festuca scabrella*) are currently found at these levels of cover and presence.

As a result and as shown in **Table 4.17.6**, future conditions under the proposed remediation scenario will result in an inadequate species composition and cover for most of the dominant species that would be expected on the SH_NA-R sites. Nonetheless, given the strong rock and gravel presence, the lack of erosion and the strong presence of native plant species, BRI recommends that no restoration activities should take place on the SH_NA-R sites. BRI recognizes that the current dearth of most expected dominant plant species for the site suggests that augmentation planting would benefit the area. Nonetheless, given existing conditions and the marginal potential benefits for the effort that would be required, active restoration is contraindicated.

Table 4.17.6. Dominant species composition under treatment scenarios, SH_NA-R.

Desired Future Condition	Dominant Habitat Species	Current Species Data*	Existing Conditions**	Remediation Outcome	Active Restoration	Intensive Restoration
Xeric Douglas fir (35% of area)	Douglas fir	1.5% on 50%	-	+	+	+
	Pinegrass	Not Present	-	-	-	+
	Douglas fir	1.5% on 50%	-	+	+	+
	Elk sedge	Not Present	-	-	-	+
Xeric Fescue grass (65% of area)	Douglas fir	1.5% on 50%	-	+	+	+
	Bluebunch wheatgrass	Not Present	-	+	+	+
	Idaho fescue	Not Present	-	-	+	+
	Bluebunch wheatgrass	Not Present	-	-	+	+
	Rough fescue	Not Present	-	-	+	+

*Average percent cover on proportion of SH_NA-R polygons.

** - inadequate cover and presence; + adequate cover and presence.

4.18 Stucky Ridge: No Action - Rock (SR_NA-R)

BRI personnel inventoried 2 SR_NA-R polygons on Stucky Ridge, covering 73 of 92 SR_NA-R designated, non-ARCO-owned acres on the site. Polygons range in size from 16 acres to 57 acres, with an average size of 36 acres. The elevations of these polygons range from a low of 1570 meters to a high of 1719 meters, with an average elevation of 1652 meters. The average slope is 12%. As shown in Table 4.18, a majority of the polygons' surfaces face East.

Table 4.18. Percentage aspect of polygons, SR_NA-R*.

East	West	North	South
61 (35)	17 (25)	4 (6)	17 (4)

*Variables are reported as: percent mean (standard deviation).

4.18.1 Dominant Ground Cover

As shown in Table 4.18.1, bare soil accounts for only one-tenth of ground cover on the SR_NA-R sites. Gravel and rock cover the remainder of the sites. There is little to no vegetation present.

Table 4.18.1. Percent ground cover, SR_NA-R*.

Site Count	Soil	Gravel	Rock	Litter	Basal Veg	Wood	Other
2	11 (12)	40 (14)	50 (0)	0 (0)	0 (0)	0 (0)	0 (0)

*Cover is reported as: percent mean (standard deviation).

4.18.2 Dominant Vegetation Cover

As shown in Table 4.18.2, very little of the SR_NA-R sites exhibits plant life. In addition, four of the five species that are present are exotics, and two of the exotics are noxious weeds, indicating that this area could serve as a minor seed source for weedy species.

Table 4.18.2.1. Plant cover (percent) and richness (count), SR_NA-R.

Variable	Forbs	Grasses	Woody	Native	Exotic = Exotic species + Noxious Weeds	Noxious Weeds
Cover	0 (0)	0 (0)	0 (0)	0 (0)	1 (0)	1 (0)
Richness	0 (0)	0 (0)	1 (0)	1 (0)	4 (2)	2 (1)

*Variables are reported as: mean (standard deviation).

Table 4.18.2.2 lists the five species present on the SR_NA-R sites. All species are present with limited cover.

Table 4.18.2.2. Dominant plant species, SR_NA-R*.

Species	Percent Cover	Polygon Presence
Horsebrush	0.5 (0)	1
Redtop	0.5 (0)	1
Spotted knapweed	0.5 (0)	1
Goatsbeard	0.3 (2)	0
Leafy spurge	0.3 (2)	0

*Cover is reported as: mean (standard deviation).

4.18.3 Erosion Type

As shown in **Table 4.18.3**, the two SR_NA-R sites show very different erosion patterns. One site has no erosion, the other significant wind erosion. One is heavily armored with rock and lacks fines; little to no short-term erosion is therefore possible. The other is also armored with rock, but exhibits some interstitial fines, which are vulnerable to erosion.

Table 4.18.3. Erosion types and coverage, SR_NA-R*.

	None	Wind	TOTAL
Polygon Area Demonstrating Erosion	0 (•)	98 (•)	46 (69)
Count	1	1	2

*Cover is reported as: percent mean (standard deviation).

• Note: no standard deviation.

4.18.4 Browse

As shown in **Table 4.18.4**, neither of the SR_NA-R sites show browse, primarily due to the lack of browsable plant material on these sites.

Table 4.18.4. Browse, SR_NA-R.

None (< 5 percent)	Light (5-25 percent)	Moderate (25-50 percent)	Heavy (>50 percent)
2	-	-	-

4.18.5 Microsite Availability

As shown in **Table 4.18.5**, both of the SR_NA-R sites have adequate microsites.

Table 4.18.5. Counts of microsites, SR NA-R.

Adequate	Moderate	Marginal	Inadequate
2	-	-	-

4.18.6 Current and Future Conditions

As shown in **Table 4.18.6**, none of the expected dominant species are currently present. The remediation prescription for these sites calls for little to no treatment, other than weed control efforts as necessary. Given existing conditions and this remediation scenario, and as shown in **Table 4.18.6**, future conditions under the proposed remediation scenario will result in an inadequate species composition and cover for most of the dominant species that would be expected on the SR_NA-R sites. Nonetheless, given the predominance of rock and gravel cover, BRI recommends that no restoration activities should take place on the SR_NA-R sites.

BRI recognizes that the current dearth of most expected dominant plant species for the sites suggests that augmentation planting could benefit the area. Further, industrial activities may well have contributed to the denuding of these zones, the loss of soil fines, and the subsequent exposure of more rock than would be present under non-disturbance conditions. Nonetheless, given existing conditions, the exorbitant effort that would be needed to attempt any reclamation planting on these sites, relative to the small benefits that might accrue, contraindicates any active restoration.

Table 4.18.6. Dominant species composition under treatment scenarios, SR_NA-R.

Desired Future Condition	Dominant Habitat Species	Current Species Data*	Existing Conditions**	Remediation Outcome	Active Restoration	Intensive Restoration
Mesic Douglas fir (3% of area)	Douglas fir	Not Present	-	-	+	+
	Huckleberry	Not Present	-	-	-	+
	Douglas fir	Not Present	-	-	+	+
	Snowberry	Not Present	-	-	+	+
Xeric Douglas fir (18% of area)	Douglas fir	Not Present	-	-	+	+
	Pinegrass	Not Present	-	-	-	+
	Douglas fir	Not Present	-	-	+	+
	Elk sedge	Not Present	-	-	-	+
	Douglas fir	Not Present	-	-	+	+
Xeric Fescue grass (79% of area)	Bluebunch wheatgrass	Not Present	-	-	+	+
	Rough fescue	Not Present	-	-	+	+
	Idaho fescue	Not Present	-	-	+	+

*Average percent cover on proportion of SR_NA-R polygons.

** - inadequate cover and presence; + adequate cover and presence.

4.19 Smelter Hill: No Action (SH_NA)

BRI personnel inventoried 5 SH_NA polygons on Smelter Hill. Polygons range in size from 6 acres to 13 acres, with an average size of 9 acres. The elevations of these polygons range from a low of 1680 meters to a high of 2169 meters, with an average elevation of 1994 meters. As shown in **Table 4.19**, most of the polygons' surfaces face North and West; relatively few of the surfaces face South.

Table 4.19. Percentage aspect of polygons, SH_NA*.

East	West	North	South
23 (33)	33 (31)	29 (32)	15 (26)

*Variables are reported as: percent mean (standard deviation).

4.19.1 Dominant Ground Cover

As shown in **Table 4.19.1**, bare soil accounts for less than 10% of ground cover on the SH_NA sites. Together, gravel and rock account for nearly one-half of the ground cover on site, with litter and basal vegetation accounting for almost another one-half.

Table 4.19.1 Percent ground cover, SH NA*.

Site Count	Soil	Gravel	Rock	Litter	Basal Veg	Wood	Other
5	8 (13)	8 (4)	40 (37)	27 (25)	21 (11)	5 (4)	1 (1)

*Cover is reported as: percent mean (standard deviation).

4.19.2 Dominant Vegetation Cover

As shown in **Table 4.19.2.1**, 80% of the SH_NA sites is covered with native plants while less than 10% is covered with exotic plant species. Woody plants dominate the species richness, but neither forb nor grass richness meets the standards of restoration (i.e., five species or more per life form). Spotted knapweed (*Centaurea maculosa*) is the only noxious weed present on site, and it only in trace amounts.

Table 4.19.2.1 Plant cover and richness, SH NA.

Variable	Forbs	Grasses	Woody	Native	Exotic	Noxious Weeds
Cover	17 (33)	10 (12)	53 (45)	80 (70)	6 (10)	0 (0)
Richness	2 (2)	3 (2)	7 (3)	13 (6)	3 (2)	1 (1)

*Variables are reported as: mean (standard deviation).

Table 4.19.2.2 shows the six species that both have the greatest cover and that are present on most SR_NA sites. Quaking aspen (*Populus tremuloides*) has the greatest average canopy cover of all species present (34%), and is present on 4 of 5 sites. The forb, fuzzy-tongue penstemon (*Penstemon eriantherus*) is widely present, as are the shrubs oregongrape (*Berberis repens*) and chokecherry (*Prunus virginiana*). Kentucky bluegrass (*Poa pratensis*) and bluebunch wheatgrass (*Agropyron spicatum*) are the most widely spread grass species.

Table 4.19.2.2. Dominant plant species, SH NA*.

Species	Percent Cover	Polygon Presence
Quaking aspen	34 (43)	4
Fuzzy-tongue penstemon	14 (31)	2
Oregongrape	5 (8)	4
Kentucky bluegrass	5 (9)	4
Bluebunch wheatgrass	6 (13)	2
Chokecherry	3 (4)	4

*Cover is reported as: mean (standard deviation).

4.19.3 Erosion Type

As shown in **Table 4.19.3**, most of the SH_NA sites lack erosion problems. One of the sites, however, demonstrates widespread, but minor, sheet and gully erosion.

Table 4.19.3. Erosion types and coverage (percentage), SH_NA*.

	None	Sheet & Gully	TOTAL
Polygon Area Demonstrating Erosion	0 (0)	60 (*)	12 (27)
Count	4	1	5

*Cover is reported as: percent mean (standard deviation).

• Note: no standard deviation.

4.19.4 Browse

As shown in **Table 4.19.4**, a majority of the sites show light browse, one shows moderate, another heavy levels.

Table 4.19.4. Browse, SH_NA.

None (< 5 percent)	Light (5-25 percent)	Moderate (25-50 percent)	Heavy (>50 percent)
3	-	1	1

4.19.5 Microsite Availability

As shown in **Table 4.19.5**, two of the sites have an adequate number of microsites, one a moderate number, and two inadequate numbers.

Table 4.19.5. Counts of microsites, SH_NA.

Adequate	Moderate	Marginal	Inadequate
2	1	-	2

4.19.6 Current and Future Conditions

As shown in **Table 4.19.6**, most of the expected dominant species are currently either absent or present in inadequate proportions on the SH_NA sites. Conservatively and for the purpose of this analysis, a dominant species' presence is considered inadequate under existing conditions if its current cover is less than 5%, and if it is present on less than 50% of the polygons that were inventoried. Only bluebunch wheatgrass (*Agropyron spicatum*) is currently found at these levels of cover and presence.

The remediation prescription for these sites calls for little to no treatment, other than weed control efforts as necessary. Given this remediation scenario, a dominant species' future presence will be adequate if its current cover will reasonably permit the spread of this species across the polygon areas. Conservatively and for the purpose of this analysis, this means 1% or greater current cover, and current presence on 50% or more of the polygons that were inventoried. Only bluebunch wheatgrass (*Agropyron spicatum*) and rough fescue (*Festuca scabrella*) are currently found at these levels of cover and presence.

As a result, future conditions under the proposed remediation scenario will result in an inadequate species composition and cover for most of the dominant species that would be expected on the SH_NA sites. Nonetheless, given the extraordinarily high cover of native plant species, the absence of significant erosion problems, heavy wildlife use evidenced by the moderate to heavy browse, an adequate number of microsites to further plant recruitment and a general absence of weeds, BRI is recommending that no restoration activities take place on these sites. BRI recognizes that the current dearth of most expected dominant plant species for these sites suggests that augmentation planting could benefit the area. Regardless, the otherwise solid ecological conditions on the SH_NA sites contraindicate the need for restoration activities at this time.

Table 4.19.6. Dominant species composition under treatment scenarios, SH NA.

Desired Future Condition	Dominant Habitat Species	Current Species Data*	Existing Conditions**	Remediation Outcome	Active Restoration	Intensive Restoration
Mesic Douglas fir (24% of area)	Douglas fir	Not present	-	-	+	+
	Huckleberry	Not present	-	-	-	+
	Douglas fir Snowberry	Not present 2.1% on 40%	- -	- -	+	+
Xeric Douglas fir (17% of area)	Douglas fir	Not present	-	-	+	+
	Pinegrass	Not present	-	-	-	+
	Douglas fir Elk sedge	Not present 0.1% on 20%	- -	- -	+	+
	Douglas fir Bluebunch wheatgrass	Not present 6.1% on 40%	- +	- +	+	+
Xeric Fescue grass (14% of area)	Idaho fescue	Not present	-	-	+	+
	Bluebunch wheatgrass	6.1% on 40%	+	+	+	+
	Rough fescue	2.3% on 80%	-	+	+	+
Mesic Fescue grass (17% of area)	Idaho fescue	Not present	-	-	+	+
	Rough fescue	2.3% on 80%	-	+	+	+
Lodgepole pine (2% of area)	Lodgepole pine	Not present	-	-	+	+
	Twinflower	Not present	-	-	-	+
	Lodgepole pine	Not present	-	-	+	+
	Grouse whortleberry	Not present	-	-	-	+
Lodgepole pine/ Douglas fir (3% of area)	Lodgepole pine	Not present	-	-	+	+
	Douglas fir	Not present	-	-	+	+
	Twinflower	Not present	-	-	-	+
	Lodgepole pine	Not present	-	-	+	+
	Douglas fir	Not present	-	-	+	+
	Grouse whortleberry	Not present	-	-	-	+
Subalpine fir (22% of area)	Lodgepole pine	Not present	-	-	+	+
	Douglas fir	Not present	-	-	+	+
	Pinegrass	Not present	-	-	-	+
	Subalpine fir	Not present	-	-	+	+
	Beargrass	Not present	-	-	-	+
	Subalpine fir Grouse whortleberry	Not present Not present	- -	- -	+	+
	Subalpine	Not present	-	-	+	+
	Pinegrass	Not present	-	-	-	+

*Average percent cover on proportion of SH_NA polygons.

** - inadequate cover and presence; + adequate cover and presence.

SECTION 5

COMPARISON OF ALTERNATIVES

Section 5: Comparison of Alternatives

The purpose of this section is to compare proposed alternatives for restoration at the IA. The three proposed alternatives are 1) No Action Alternative, 2) Active Restoration Alternative, and 3) Intensive Restoration Alternative. These alternatives vary in their intensity of effort and cost. Initial conditions as determined by the chosen alternative result in different risks, outcomes, and length of time to recovery.

Objectives of this section are:

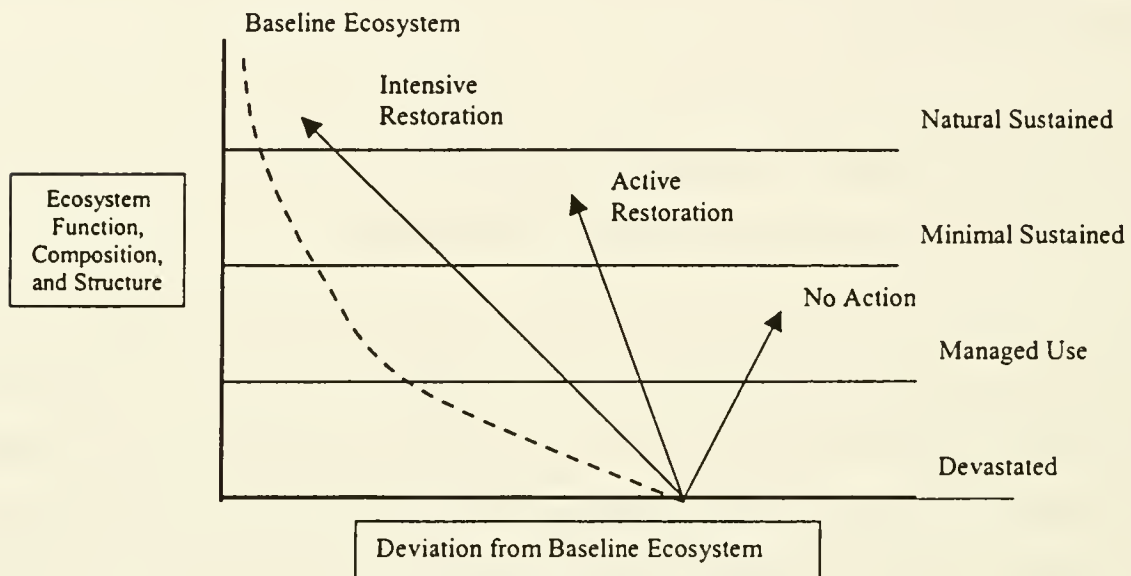
- To provide a comprehensive comparison of alternatives.
- To present detailed prescriptions and costs for each alternative.

Alternatives were evaluated based upon a model developed by the Department of Interior for natural resource damage assessments (DOI 1994). Consideration is given to the primary strategy for restoration, technical feasibility, coordination with remedy, anticipated ecological response, effectiveness of restoration, potential for additional injury, potential effects on human health and safety, appropriate application, time for recovery to baseline, and anticipated cost. The final decision for choosing the alternative will be made by the Trustee of natural resources for the State of Montana.

The alternatives consider three potential outcomes as illustrated in **Figure 5.1**. Degradation of the original ecosystem is described by the descending dashed line and represents the loss of function and structure inherent in the baseline ecosystem. Remedy, active restoration, and intensive restoration follow separate trajectories that restore portions of the original function or structure. Remedy, for example, may follow a trajectory that creates plant communities, which are dissimilar to baseline, but nonetheless achieves a minimally sustained or managed use system. In contrast, active restoration may result in the restoration of functionality and a minimally sustained plant community that only partially resembles baseline structure and composition. The trajectory of intensive restoration efforts bears the closest resemblance to the baseline ecosystem in terms of structure, composition, and function. The result of intensive restoration will be a natural

sustained community with durability to naturally occurring events such as drought or weed invasion.

Figure 5.1. Potential trajectories resulting from restoration alternatives as modified from (Traynor and Rieger 1997).



The proposed alternatives rely upon techniques commonly used within the agricultural, forestry, and mine reclamation industries. The tools and products required are commercially available as are companies experienced in the implementation of these techniques. Several opportunities are available to coordinate activities with remedy as described in the Remedial Action Work Plans (AERL 2002; AERL 2001b,c,d,e,f,g,h,i,j). A summary of the proposed treatments follows in **Table 5.1**. A summary of the proposed alternatives follows in **Table 5.2**.

Table 5.1. Summary of treatments for alternatives.

	Tillage (T6 & T12)		Vegetation Improvement (VI)		Steep Slope Reclamation (SSR)		Well Vegetated (WV)	
	Active Restoration	Intensive Restoration	Active Restoration	Intensive Restoration	Active Restoration	Intensive Restoration	Active Restoration	Intensive Restoration
Site Preparation/ Amelioration Treatments								
Aerial Application of Agricultural Lime (Specification 6.1)					X	X		
Aerial Application of Fertilizers- Initial Rate (Specification 6.4)					X	X		
Aerial Application of Compost (Specification 6.5)						X		
Mechanical Compost Application/ Incorporation (Specification 6.6)		X						
Mechanical Fertilizer Application- Initial Rate (Specification 6.8)	X	X						
Mechanical Compost Application- Surface (Specification 6.9)	X		X	X				
Seeding/ Planting Treatments								
Aerial Seeding (Specification 6.2)						X		
Aerial Application of Hydromulch (Specification 6.3)						X		
Broadcast Seeding- Enhanced Mix (Specification 6.7)		X		X				
Restoration Enhancement Planting- 500 plants/acre (Specification 6.10)	X		X		X		X	
Restoration Enhancement Planting- 1,000 plants/acre (Specification 6.10)		X		X		X		X
Install Plant Protectors (Specification 6.11)	X	X	X	X	X	X	X	X
Maintenance								
Aerial Application of Fertilizers-Maintenance Rate (Specification 6.12)		X		X		X		
Maintenance of Plant Protectors (Specification 6.13)	X	X	X	X	X	X	X	X
Replacement Plant Installation (Specification 6.14)	X	X	X	X	X	X	X	X
Noxious Weed Control (Specification 6.15)	X	X	X	X	X	X	X	X
Restoration Monitoring (Specification 6.16)	X	X	X	X	X	X	X	X

Table 5.2. Summary of alternatives.

Primary Strategy	No Action—Natural Recovery	Active Restoration	Intensive Restoration
Techniques	Natural recovery	Active planting efforts with surface soil treatments.	Active planting efforts with surface and sub-surface soil treatments
	Remedial action treatments	Remedial Action Treatments Restoration enhancement plantings (500 stems/acre) Organic Fertilizer application Aerial Lime application on SSR Surface compost application (34 cy/ac) Biological Noxious weed control	Remedial Action Treatments Sub-surface compost application (200+ cy/ac) Restoration enhancement plantings (1000 stems/acre) Fertilizer application/maintenance Lime and seed application on SSR Surface compost application Noxious weed control
Technical Feasibility	Actions are technically feasible	Actions are technically feasible and typical of forestry and mineland reclamation/products commercially available	Actions are technically feasible and typical of mineland and contaminated site reclamation/products are commercially available
Coordination with Remedy	No coordination required	Possible to coordinate several functions and reduce project costs	Possible to coordinate several functions and reduce project costs
Anticipated Ecological Response	Functional replication	Functional and partial structural replication.	Functional and partial structural replication
Effectiveness & Risks of Strategy	High risk—resulting restoration may not recover to baseline and further degrade	Moderate risk—mid-successional species will establish, but soil factors may inhibit further succession and extend recovery	Low risk—mid- and late-successional species will establish, full structural restoration may not occur
Potential of Additional Injury	Potential erosion and noxious weed invasion on slopes	Soil disturbance will possibly result in noxious weed establishment	Soil disturbance will possibly result in noxious weed establishment
Potential Effects on Human Health and Safety	Extended exposure to COCs from eroding slopes	Short-term exposure to implementation crews to COCs	Short-term exposure to implementation crews to COCs
Appropriate Application Area	WV adjacent to native stands	Sites with limited species diversity and soils with chemical and physical deficiencies	Sites with limited species diversity and soils with chemical and physical deficiencies as well as requiring minimum time to recovery
Time for Recovery to Baseline	>500 years	<100 years	<50 years
Anticipated Costs	\$ 0.00	\$27,656,257	\$72,357,000

5.1 Restoration Alternatives

5.1.1 No Action Alternative

5.1.1.1 Primary Strategy. The primary strategy for restoration will be no action.

5.1.1.2 Technical Feasibility. The sites will be reclaimed according to remedy treatments proposed within the Preliminary Design Packages and Remedial Action Work Plans without the benefit of further action.

5.1.1.3 Coordination with Remedy. No coordination required.

5.1.1.4 Anticipated Ecological Response. Areas restored via the No Action Alternative will follow a trajectory of continued recovery, a steady state consisting of planted vegetation, or site degradation with no recovery. The vegetation resulting from remedy actions will consist of grasslands, tree and shrub plantings on steep slopes, areas of existing vegetation considered adequate by LRES WV, and existing stands of aspen. Natural recovery will rely heavily upon the proximity of native stands of vegetation and the ability of individual species to invade established vegetation. Species that successfully colonize will be those transported by wind or dominant users of the created habitats and adapted to coarse seed beds and moderate competition.

The restoration resulting from the No Action Alternative will be characterized by the following:

- 1) Soils will be stabilized with no erosion, but remain highly mineralized and low in fertility.
- 2) Plant species richness will consist of native and non-native reclamation plant species.
- 3) Plant establishment will occur predominantly adjacent to existing stands of native vegetation.
- 4) Metal tolerant species will be the dominant component of the plant community.
- 5) Vegetation patterns will not necessarily replicate the natural distribution of native vegetation.

5.1.1.5 Effectiveness and Risk of Strategy. Reclaimed grasslands and WV areas will lack the structural and compositional features of the baseline fescue grassland communities. Based upon the Remedial Action Work Plans, grass plantings will include drought tolerant, rhizomatous

species with a minor component of forbs adapted to disturbance conditions. Minimal insect pollinated species will be reintroduced. Grass and forb species dominant under baseline conditions (i.e.--rough fescue and Idaho fescue) will not be included within the seed mix. Neither the dominant grasses nor forbs will return to grassland sites via natural recovery.

Reclaimed steep slope areas will also lack the structural and compositional features of the baseline plant communities. Based upon the Remedial Action Work Plans, a variety of native woody species will be planted on steep slopes identified as SSR-1. The work plan does not differentiate between the baseline condition and the proposed condition, however. For example, slopes that were originally grassland may be planted to woody species. Residual damage or the contaminated soils between the planted woody species will not be limed and will remain phytotoxic according to the work plan. Therefore, these areas will be dominated by metals tolerant grasses and weed species indefinitely. Species typical of baseline conditions will not recover naturally on these sites.

Functionally, plant cover resulting from remedy efforts will result in adequate erosion control and provide limited forage for wildlife. Forage will be limited to grass species within grassland remedy areas, woody browse on steep slopes and those areas of existing vegetation. The ability to provide for adequate retention and cycling of nutrients is uncertain. Remedy will provide compost application to limited sites that will serve to increase the retentive qualities of the soil. In addition, fertilization will occur with standard conventional fertilizer to increase soil fertility. Given the characteristic high solubility of conventional fertilizers, this fertility may be quickly lost unless compost or vegetation can retain or incorporate nutrients into less soluble forms.

Durability of this restoration will be limited based upon the ability of cover and complexity of vegetation to prevent weed invasion and a potentially limited nutrient pool. Steep Slope Reclamation areas will remain highly susceptible to weed invasion due to areas of bare ground and residual contamination.

5.1.1.6 Potential for Additional Injury. Inadequate plant coverage may result in further erosion on steep slopes and the expansion of noxious weed infestations

5.1.1.7 Potential Effects on Human Health and Safety. Extended time to recovery may result in wind and water erosion on steep slope areas where residual contamination exists. Consequently, humans will be further exposed to elevated levels of COCs.

5.1.1.8 Appropriate Application. This alternative would be appropriately applied on areas adjacent to healthy stands of native vegetation and on soils with physical, chemical, and biological properties similar to baseline conditions. Specifically, this alternative would be appropriately applied on well-vegetated sites adjacent to native vegetation stands.

5.1.1.9 Time for Recovery to Baseline. Recovery to baseline is dependent upon erosion control, noxious weed control, the establishment of a litter layer, reproduction of planted species on the limited areas addressed under remedy, invasion of native species typical of baseline habitat types, and the establishment of a multi-layered canopy. While some natural resources on the IA will move toward baseline conditions over time, in the absence of substantial restoration efforts, the degree of recovery and total area on which recovery occurs will be contingent upon soil development processes and the ability of individual species characteristic of baseline to migrate and invade successfully, and recovery will be limited due to residual injury on the steep slope areas. Under the No Action Alternative, recovery to conditions somewhat similar to baseline on the IA will not occur for a time period in excess of 500 years.

5.1.1.10 Anticipated Cost. Total cost for this alternative is \$ 0.00.

5.1.2 Active Restoration Alternative

5.1.2.1 Primary Strategy. The primary strategy for restoration will be active planting efforts to increase plant species richness and surface soil treatments.

5.1.2.2 Technical Feasibility. The sites will be reclaimed according to remedy treatments proposed within the Preliminary Design Packages and Remedial Action Work Plans. All products are commercially available and techniques are actively used by the agriculture, forestry, and mine reclamation industries. In addition, active restoration efforts will include:

- Restoration enhancement plantings (addition of 5 species @ 100 stems/acre)
- Fertilization
- Compost application
- Lime application on SSR areas

5.1.2.3 Coordination with Remedy. Plantings, fertilization, compost application, and lime application on SSR areas could be coordinated with remedy to reduce overall costs.

5.1.2.4 Anticipated Ecological Response. Areas restored via the Active Restoration Alternative will follow a trajectory of continued recovery. Active restoration efforts will initiate restoration planting efforts designed to increase species richness and density of native vegetation as well as minor modifications of the soils chemical and physical characteristics.

The restoration resulting from the Active Restoration Alternative will be characterized by the following:

- 1) Soils will be capable of supporting disturbance, early, and mid-successional species, and consist primarily of highly mineral, low fertility substrates.
- 2) Plant species richness will consist of mid-successional species that are both wind- and insect-pollinated.

- 3) Plant recovery will occur across the entire site regardless of proximity to native stands of vegetation.
- 4) A greater acreage of contaminated site will be reclaimed and residual contamination reduced.
- 5) Annual and noxious weed species or metal tolerant species will be a minor component of the plant community.
- 6) Vegetation patterns will be similar to the natural distribution of native vegetation.

5.1.2.5 Effectiveness and Risk of Strategy. All actively restored areas will partially resemble baseline conditions in terms of structural and compositional features. Grasslands will contain the dominant grass species typical of baseline (rough fescue and Idaho fescue) as well as numerous forb and native legume species. The addition of surface compost will alter seed bed texture and allow for invasion of additional species adapted to finer textured soils and greater recruitment from seeding efforts. Due to liming efforts on SSR sites, active restoration will extend the structural and compositional components of baseline grasslands to areas not addressed by remedy and in the No Action Alternative. In terms of species richness, however, active restoration will fall short of baseline conditions.

Forest restoration efforts will distribute mid-successional tree and shrub species across the extent of the disturbed sites thus encouraging more timely canopy coverage on forested sites and a greater potential for invasion of species adapted to shade conditions. In addition, tree and shrub coverage distributed across forested sites will provide browse and hiding cover for wildlife thus encouraging the transport of bird and animal transported seed. In addition, forest restoration efforts will be extended to areas that were previously forested but are identified for grassland establishment by LRES. Forest restoration efforts will also fall short of baseline but will encourage succession and invasion by other native species.

Functionally, plant cover resulting from active restoration will result in adequate erosion control and provide for expanded wildlife forage above the No Action Alternative. Forage within grasslands will be more productive due to fertilization and a greater variety of grass and forb species. In addition, insect populations will be encouraged through the planting of insect pollinated species. The Active Restoration Alternative will provide for better retention and

cycling of nutrients above the No Action Alternative. Addition of compost will increase nutrient retention in soils allowing for a more efficient use of fertilizer. Also, organic fertilizer additions will provide for extended release of nutrients throughout the growing season and result in greater utilization and cycling of nutrients. Thus, a better structural and compositional replication will be achieved. Fertilization and compost addition will not, however, substantially improve deeper soil structure and moisture retention.

The Active Restoration Alternative will improve site durability and reduce risks above the No Action Alternative. As a result of increased plant vigor and species richness, the site is anticipated to become less susceptible to invasive weeds and to provide a measure of resistance to drought and future disturbance.

5.1.2.6 Potential for Additional Injury. Activities associated with restoration techniques (deployment of vehicles, foot traffic, and hand planting) will result in minor soil disturbance and possible noxious weed establishment.

5.1.2.7 Potential Effects on Human Health and Safety. Implementation crews will be exposed to COCs on sites during the summer and fall implementation periods.

5.1.2.8 Appropriate Application. This alternative would be appropriately applied on areas containing limited species richness and soils with physical and chemical deficiencies. Specifically, this could be applied to remedy treatments referred to as tillage treatments, steep slope reclamation, vegetation improvement, and well vegetated.

5.1.2.9 Time for Recovery to Baseline. Under the Active Restoration Alternative, recovery time to baseline will be shorter than under the No Action Alternative due to the extension of plantings across the entire area of disturbance and to the appropriate distribution of grassland and woody species across the site. Recovery will be judged as the successful control of erosion, control of noxious weeds, establishment of a litter layer, reproduction of planted species and invasion of native species typical of habitat types, and the establishment of a multi-layered canopy. Not

considered is the development of soils, which may take centuries to accomplish. Anticipated time to full recovery is between 50 and 100 years.

5.1.2.10 Anticipated Cost. Total cost for this alternative is \$ 27,656,257. Treatment costs on a per acre basis are as follows: Tillage (T6/T12) = \$5,148; VI = \$4,500; SSR = \$8,572; WV = \$3,527.

5.1.3 Intensive Restoration Alternative

5.1.3.1 Primary Strategy. The primary strategy for restoration will be intensive planting efforts to increase species richness as well as surface and subsurface soil treatments.

5.1.3.2 Technical Feasibility. The sites will be reclaimed according to remedy treatments proposed within the Preliminary Design Packages and Remedial Action Work Plans. All products are commercially available and techniques are actively used by the agriculture, forestry, mine reclamation, and contaminated site cleanup industries. In addition, intensive restoration efforts will include:

- Subsurface compost application at time of remedy implementation
- Restoration enhancement plantings (addition of 10 species @ 100 stems/acre)
- Fertilization
- Surface compost application
- Lime and seed application on SSR areas
- Maintenance Fertilization

5.1.3.3 Coordination with Remedy. Plantings, fertilization, compost application, and lime/seed application on SSR areas could be coordinated with remedy to reduce overall costs.

5.1.3.4 Anticipated Ecological Response. Areas restored via the Intensive Restoration Alternative will follow a trajectory of accelerated recovery with minimal emphasis on natural recovery. Intensive restoration efforts will focus on altering the soil structure of degraded sites through the incorporation of compost in order to promote the restoration of a broader range of plant species. This alternative will initiate restoration planting efforts designed to increase species richness and density of native vegetation. Productivity and nutrient cycling will be encouraged through maintenance fertilization, as well.

The restoration resulting from the Intensive Restoration Alternative will be characterized by the following:

- 1) Soils will be capable of supporting all levels of successional plant species, retain soil moisture and nutrients at depth, and attain moderate levels of soil organic matter.
- 2) Plant species richness will consist of mid- to late-successional species that are both wind- and insect-pollinated.
- 3) Plant recovery will occur across the entire site regardless of adjacency to native stands of vegetation.
- 4) A greater acreage of the IA will be addressed.
- 5) Annual and noxious weed species or metal tolerant species will not be present within the plant community.
- 6) Vegetation patterns will be similar to the natural distribution of native vegetation.

5.1.3.5 Effectiveness and Risk of Strategy. All actively restored areas will partially resemble baseline conditions in terms of structural and compositional features. Grasslands will contain the dominant grass species typical of baseline (rough fescue and Idaho fescue) as well as numerous forb and native legume species. The addition of surface compost will alter seedbed texture and allow for invasion of additional species adapted to finer textured soils and greater recruitment from seeding efforts. Due to liming and seeding efforts on SSR sites, intensive restoration will extend the structural and compositional components of baseline grasslands to areas not addressed by either remedy or the Active Restoration Alternative. In terms of species richness, intensive restoration will result in more plant species than the No Action and Active Restoration Alternatives. It will, however, fall short of baseline conditions.

Forest restoration efforts will distribute mid-successional tree and shrub species across the extent of the disturbed sites. The deeper soil profile and higher moisture retention created by sub-surface compost application will allow the planting of a more diverse, moisture dependent plant community. Planting of a higher density and number of species than the Active Restoration Alternative will encourage more timely canopy coverage on forested sites and a greater potential for invasion of species adapted to shade conditions. In addition, tree and shrub coverage distributed across forested sites will provide browse and hiding cover for wildlife, thus encouraging the transport of bird and animal transported seed. In addition, forest restoration

efforts will be extended to areas that were previously forested but are identified for grassland restoration by LRES. Forest restoration efforts will increase species richness above the No Action and Active Restoration Alternatives. This alternative will fall short of baseline, but will encourage succession and invasion by other native species.

Functionally, plant cover resulting from active restoration will result in adequate erosion control and provide for expanded wildlife forage above the other alternatives. Forage within grasslands will be more productive due to fertilization and a greater variety of grass and forb species. In addition, insect populations will be encouraged through the planting of insect pollinated species. The deeper soil depths provided by the Intensive Restoration Alternative will provide for greater moisture above the No Action and Active Restoration Alternatives. Addition of surface and subsurface compost will substantially increase nutrient retention in soils allowing for a more efficient use of fertilizer and greater productivity. Also, organic fertilizer additions and maintenance fertilization will provide for extended release of nutrients throughout the growing season and result in greater utilization and cycling of nutrients. Thus, structural and compositional replication will be achieved in a shorter time period than other alternatives. Fertilization and compost addition will substantially improve deep soil structure.

Intensive restoration will improve site durability and reduce risks above other alternatives. As a result of increased plant vigor and species richness, the site is anticipated to become less susceptible to invasive weeds and to provide a high measure of resistance to drought and future disturbance.

5.1.3.6 Potential for Additional Injury. Activities associated with restoration techniques (deployment of vehicles, foot traffic, and hand planting) will result in minor soil disturbance and possible noxious weed establishment.

5.1.3.7 Potential Effects on Human Health and Safety. Implementation crews will be exposed to COCs on sites during the summer and fall implementation periods.

5.1.3.8 Appropriate Application. This alternative would be appropriately applied on areas containing limited species richness and coarse soils with low organic matter values and the inability to retain moisture or areas in which a minimal time to recover natural resources is required. This alternative could be effectively applied to tillage treatments.

5.1.3.9 Time for Recovery to Baseline. Recovery time to baseline will be substantially reduced below other alternatives due to sub-surface application of compost and the expansion of planting efforts across the entire area of disturbance as well as the appropriate distribution of grassland and woody species across the site. Recovery will be judged as the successful control of erosion, control of noxious weeds, establishment of a litter layer, reproduction of planted species and invasion of native species typical of habitat types, and the establishment of a multi-layered canopy. Not considered is the development of soils, which may take centuries to accomplish. Anticipated time to recover is less than 50 years.

5.1.3.10 Anticipated Cost. Total cost for this alternative is \$ 72,357,000. Treatment costs on a per acre basis are as follows: Tillage (T6/T12) = \$ 17,410; VI = \$ 8,624; SSR = \$ 20,121; WV = \$ 6,926.

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SECTION 6

RESTORATION TREATMENTS AND SPECIFICATIONS

Section 6: Restoration Treatments and Specifications

6.1 Aerial Application of Agricultural Lime- (Steep Slope Reclamation sites)

6.1.1 Scope Of Work

6.1.1.1 Definition. Liming is a common agricultural technique used to neutralize acidic soil conditions and provide favorable conditions for vegetation establishment and to improve plant growth. An agricultural liming material is defined as a material containing calcium (Ca) and/or magnesium (Mg) compounds capable of neutralizing soil acidity. Calcium carbonate or mixtures of calcium and magnesium carbonate are the most common materials used for liming soils. For steep hillsides or areas with variable terrain, agricultural lime is applied aerially in a slurry form using customized helicopters outfitted with specialized equipment, usually a holding tank combined with a blending apparatus capable of holding and mixing the slurry ingredients. This equipment permits the operator to hydraulically spray the mixture over the site.

6.1.1.2 Technical Feasibility.

- A. The Aerial Application of Agricultural Lime is specified to address the need to adjust pH levels in selected soils within the IA toward neutral (a value of 7). Soils for which analyses have indicated pH levels less than 6 at depth have been identified as requiring treatment and mitigation to allow successful revegetation. The adjustment of soil pH is necessary to reduce the mobility of copper (Cu), zinc (Zn), lead (Pb), and cadmium (Cd) in soils. Mobilization of metals in the soil by low pH conditions results in an increased risk of phytotoxicity, increased risk of groundwater contamination, and increased risk to aquatic receptors receiving surface water runoff (EPA 2001). Lime additions as a means to modify soil pH are currently proposed as part of the remedial actions for sites that are accessible by machinery (slopes <3:1). This specification will address the modification of soil pH on sites that are considered inaccessible by such machinery but nonetheless will require these treatments to enable successful revegetation.
- B. Low soil pH has been observed by both ARCO and Agency scientists as a consequence of mineral processing and smelting within the IA. During both the LRES Phase II

sitewide inventory and LRES Phase III sampling, low pH conditions were observed in the soil across broad areas of the site that were barren or sparsely vegetated (EPA 2001). These observations indicate that the Aerial Application of Agricultural Lime is appropriate for specified sites within the IA.

- C. The Aerial Application of Agricultural Lime is specified to address soil acidity concerns and to reduce trace element availability in order to facilitate successful revegetation on SSR treatment areas within the IA.

6.1.1.3 Coordination With Remedy.

- A. The Aerial Application of Agricultural Lime is specified for remedy sites designated as SSR. On these sites, the modification of soil pH via liming is not addressed in the proposed remedial action. Thus, this treatment represents an additional work item for SSR sites. This work item is specified to be implemented following slope recontouring or construction of on-slope engineering controls. Furthermore, this activity shall occur prior to revegetation plantings, such as PTSG as proposed in the Remedial Action Work Plans (AERL 2002; AERL 2001b,c,d,e,f,g,h,i,j) in order to allow sufficient time for pH modification and soil amelioration.
- B. The Aerial Application of Agricultural Lime is specified to occur during the Fall of Year Seven.

6.1.2 Products and Materials

6.1.2.1 Agricultural Lime.

- A. The lime product specified for use with this treatment shall be an agricultural-grade dolomitic lime that can be mixed into a slurry to allow for hydraulic application.
- B. Dolomitic lime shall be applied to specified sites at a rate of 7.5 tons/acre. Cost estimates are based on a unit cost of \$72/ ton of dolomitic lime. (Source: Continental Lime)

6.1.2.2 Helicopter Spreader.

- A. The equipment specified for use with this treatment shall be a helicopter outfitted with a holding tank combined with a blending apparatus capable of holding and mixing the slurry ingredients.
- B. Cost estimates are based on a unit price of \$4,183.58/ acre of helicopter liming. (Source: Erickson Air Crane and Tri-State Hydroseeding)

6.2 Aerial Seeding- (Steep Slope Reclamation sites, under Intensive Restoration Alternative)

6.2.1 Scope Of Work

6.2.1.1 Definition. Aerial seeding is a form of broadcast seeding that is commonly used in agriculture, reforestation, and the rehabilitation of large, burned areas. It involves the use of either fixed-wing aircraft or helicopters outfitted with specialized broadcasting equipment to spread a dry mixture of seed efficiently over large areas, without damage to existing vegetation on the site. This technique is generally suited for inaccessible areas with gentle to moderate slopes.

6.2.1.2 Technical Feasibility.

- A. This treatment is specified to address the need to establish a self-sustaining, dense cover of native grasses on steep, inaccessible sites for the purposes of long-term, sustainable erosion control, soil stabilization, and habitat enhancement. The use of this treatment assumes that a measure of overall site stability has been achieved on steep slope areas through other means such as the implementation of on-slope engineering controls to control storm water drainage and sediment transport, and slope recontouring, regrading and reshaping to minimize COC transport, as specified in the the Remedial Action Work Plans (AERL 2002;AERL 2001b,c,d,e,f,g,h,i,j). Engineering controls such as those specified will serve only to prevent the offsite transport of surficial runoff and sediment, while ignoring the cause and source of such sediment transport. The agents that cause such surficial erosion features are wind, water, and ice acting upon unprotected (bare)

soils. The prescribed seeding treatment will address the source of these erosion concerns by establishing a dense coverage of native grasses on these sites. A tight, dense cover of grass or herbaceous vegetation provides one of the best protections against surficial rainfall and wind erosion because they absorb rainfall energy, prevent soil detachment, filter sediment from runoff, increase surface roughness and slow runoff velocities, and maintain soil porosity and permeability (Gray and Sotir 1996). Additionally, this seeding treatment is prescribed in order to meet the restoration goals of establishing a native vegetation cover that is similar in composition and structure to baseline conditions observed at the RA.

- B. Field observations and data collected on sites within the IA indicate that Aerial Seeding is appropriate for all SSR sites within the IA. Specifically, Aerial Seeding will address the low overall cover of native grass and herbaceous species and the fact that native grass and herbaceous species richness does not meet the standards for restoration of these sites.
- C. For steep and variable mountainous terrain, helicopter seeding is the most appropriate application method due to the versatility and maneuverability of the equipment. This Plan specifies the use of helicopter seeding for all SSR areas of the IA.

6.2.1.3 Coordination With Remedy.

- A. Aerial Seeding is specified for remedy sites designated as SSR. On these sites, the establishment/ enhancement of an herbaceous cover (grass and forbs) sufficient to control surficial erosion and restore native habitats to baseline conditions is not addressed in the proposed remedial action. Thus, this treatment represents an additional work item for SSR sites. This work item is specified to be implemented following slope recontouring or construction of on-slope engineering controls and pH modification via liming. Furthermore, this activity shall occur prior to revegetation plantings, such as PTSG as proposed in the Remedial Action Work Plans (AERL 2002; AERL 2001b,c,d,e,f,g,h,i,j).
- B. Aerial Seeding is specified to occur during the Spring of Year Eight.

6.2.2 Products and Materials

6.2.2.1 Native Seed Mix.

- A. The seed mix specified for use with this treatment shall consist of native grass and forb species from an appropriate local or regional seed source. Selected species shall include dominant species representative of mid- to late-successional phases of the individual native habitat types to be restored.
- B. Native grass and forb seed shall be applied to specified sites at a rate of 40 pounds/acre. Cost estimates are based on a unit cost of \$18/ pound of native grass and forb seed. (Source: Granite Seed)
- C. A typical seed mix for Aerial Seeding on specified sites of the IA is as follows:

Table 6.2.2.1.1. Typical seed mix for all treatment areas.

Grasses		% mix
Bluebunch Wheatgrass	<i>Agropyron spicatum 'Goldar'</i>	15.0%
Sheep Fescue	<i>Festuca ovina 'Durar'</i>	15.0%
Basin Wildrye	<i>Elymus cinereus 'Trailhead'</i>	15.0%
Bottlebrush Squirreltail	<i>Sitanion hystrix</i>	15.0%
Tufted Hairgrass	<i>Deschampsia cespitosa</i>	15.0%
Sandberg bluegrass	<i>Poa sandbergii (P. secunda)</i>	15.0%
	Subtotal	90.0%
Forbs		
Fireweed	<i>Epilobium angustifolium</i>	3.0%
Rocky Mountain Penstemon	<i>Penstemon strictus</i>	1.0%
Blue Flax	<i>Linum lewisii</i>	1.0%
Arrowleaf Balsamroot	<i>Balsamorhiza sagittata</i>	1.0%
Lacy Phacelia	<i>Phacelia tenacetifolia</i>	1.0%
	Subtotal	7.0%
Legumes		
Lupine	<i>Lupinus argenteus</i>	1.0%
Alfalfa	<i>Medicago sativa 'Ladak'</i>	1.0%
Hairy Vetch	<i>Vicia villosa</i>	1.0%
	Subtotal	3.0%
	Grand Totals	100.0%

6.2.2.2 Helicopter Spreader.

- A. The equipment specified for use with this treatment shall be a dry slung fertilizer or seed bucket similar to an Isolair 2600-45H or the equivalent. The seed bucket shall be suspended from a helicopter capable of supporting the bucket fully loaded (approx. 2500 lbs.).
- B. Cost estimates are based on a unit price of \$30.32/ acre for aerial seeding. (Source: Minuteman Aviation)

6.3 Aerial Application of Hydromulch- (Steep Slope Reclamation, under Intensive Restoration Alternative)

6.3.1 Scope Of Work

6.3.1.1 Definition. The term hydromulch refers to a combination of water, mulch, and tackifier (a type of organic polymer or glue-like substance) that is sprayed on a disturbed site after seeding. Hydromulches are applied to soils primarily to bind newly applied seed to the soil, reduce surficial erosion, reduce evapotranspiration from the soil surface, reduce soil surface temperatures, and prevent soil crusting. Erosion control elements of the mix, such as virgin wood fiber mulch and tackifiers, can provide benefits for up to one year after application. The Aerial Application of Hydromulch involves the use of customized helicopters outfitted with specialized equipment, usually a holding tank combined with a blending apparatus capable of mixing the ingredients into a slurry. This equipment permits the operator to hydraulically spray the mixture over the site. The ability of hydromulch to disperse mulch, fertilizers, and tackifiers simultaneously contributes to the economy of operation of these machines in large-scale operations.

6.3.1.2 Technical Feasibility.

- A. This treatment is specified in combination with the Aerial Seeding of SSR sites (Specification 6.2) in order to address the need to bind newly applied seed to the soil

surface, protect the seed from erosion, and to enhance germination. This seeding method is commonly referred to as the “two-pass method” in which seed is applied during the “first pass” and hydromulch is applied on top of the seed during the “second pass”. In addition to mulch materials, fertilizers may also be incorporated into the slurry and applied simultaneously (**Specification 6.4**).

- B. Field observations and data collected on sites within the IA indicate that Aerial Seeding (**Specification 6.2**) is appropriate for all SSR sites within the IA. The Aerial Application of Hydromulch is a companion treatment to this specification. Refer to **Section 4** for a full discussion of these field observations and collected data.
- C. For steep and variable mountainous terrain, aerial hydromulching via helicopter is the most appropriate method due to the versatility and maneuverability of the equipment. This Plan specifies aerial hydromulching for all SSR areas of the IA.

6.3.1.3 Coordination With Remedy.

- A. The Aerial Application of Hydromulch is a companion treatment to Aerial Seeding (**Specification 6.2**) and is specified for remedy sites designated as SSR. On these sites, the establishment/ enhancement of an adequate herbaceous cover (and similarly, the need for hydromulch) is not addressed in the proposed remedial action. Thus, this treatment represents an additional work item for SSR sites. Similar to Aerial Seeding (**Specification 6.2**), this work item is specified to be implemented following slope recontouring or construction of on-slope engineering controls and pH modification via liming. Furthermore, this activity shall occur prior to revegetation plantings, such as PTSG as proposed in the Remedial Action Work Plans (AERL 2002; AERL 2001b,c,d,e,f,g,h,i,j).
- B. The Aerial Application of Hydromulch is specified to occur during the Spring of Year Eight, immediately following Aerial Seeding.

6.3.2 Products and Materials

6.3.2.1 Mulch.

- A. The mulch materials specified for use with this treatment shall consist of virgin wood fiber mulch typical to that used in the hydroseeding industry, such as the product “EcoFibre” or the equivalent.
- B. Mulch shall be applied to the specified sites at a rate of 1 ton/ acre. Cost estimates are based on a unit price of \$320/ ton for mulch materials. (Source: FMI/Kopp)

6.3.2.2 Tackifiers.

- A. The tackifiers specified for use with this treatment include a combination of materials to be incorporated with the mulch materials specified above. Tackifiers shall include fibrous tackifier, such as the product “Finnfibers” or the equivalent, polymer tackifier, such as the product “SoilMaster WR” or the equivalent, and a guar tackifier.
- B. Fibrous tackifiers shall be applied to the specified sites at a rate of 30 lbs./ acre. Polymer tackifiers shall be applied to the specified sites at a rate of 70 gals./ acre. Guar tackifiers shall be applied to the specified sites at a rate of 50 lbs./ acre. Cost estimates are based on a unit price of \$6/ gallon for polymer tackifiers, \$2.50/ pound for fibrous tackifiers, and \$1.70/ pound for guar tackifiers. (Source: FMI/Kopp and Revex)

6.3.2.3 Helicopter Hydromulcher.

- A. The equipment specified for use with this treatment shall be a helicopter outfitted with a holding tank combined with a blending apparatus capable of holding and mixing the slurry ingredients.
- B. Cost estimates are based on a unit price of \$2,767.57/ acre of helicopter hydromulching. (Source: Erickson Air Crane and Tri-State Hydroseeding)

6.4 Aerial Application of Fertilizers- Initial Rate- (Steep Slope Reclamation sites)

6.4.1 Scope Of Work

6.4.1.1 Definition. The application of sustained-release, organic-based fertilizers to disturbed sites will facilitate short-term native plant establishment and growth and will regenerate the plant-soil communities and processes that sustain vegetative growth indefinitely. The specified fertilizer products are characterized by a moderate initial release of nitrogen (N) and slower long-term N release from the decomposition of organic materials and blends. The specified products are available in dry, pelletized form and can be applied using either fixed-wing aircraft or helicopters outfitted with specialized broadcasting equipment, or as a component of a slurry application of hydromulch (**Specification 6.3**). These techniques are generally suited for inaccessible areas with gentle to moderate slopes.

6.4.1.2 Technical Feasibility.

- A. This treatment is specified to address the regeneration of soil health and fertility in order to support (restore) a healthy stand of self-sustaining native vegetation. Disturbed sites must undergo primary succession and soil regeneration before they can support plant cover similar to adjacent vegetated areas. Studies indicate that plant growth on degraded soils is often nutrient limited, and that low soil nitrogen (N) is the most common limiting element (other than water) (Claassen and Hogan 1998). Poor soil fertility and physical characteristics can only be sustainably remediated by consistent plant growth on the site, indicating the need to apply fertilizers (supplemental N sources) to disturbed sites to support plant growth and improve soil structure. Sustained plant growth is also expected to generate secondary beneficial effects, including deposition of erosion resistant mulch layers, addition of moisture retaining soil organic matter, regeneration of pools of plant available nutrients, and the generation of water-stable soil aggregates. Soluble N amendments from standard agricultural fertilizers are incompatible with the goals of reestablishing native vegetation as these products are characterized by a rapid release of nutrients that have been shown to favor the growth of weedy annuals and exotic vegetation, to the detriment of establishing native vegetation (Claassen and Hogan 1998).

The specified fertilizer products are compatible with the goals of establishing native vegetation as the relatively lower short term N availability restricts weedy invasion while the large, organically stabilized reserve provides continued N release for multiple years.

- B. Field observations and data collected on sites within the IA indicate that the Aerial Application of Fertilizers is appropriate for all SSR sites within the IA. Specifically, such fertilizer treatments will address the overall low percentage of vegetative cover on these sites and are compatible with other specified treatments for these sites such as Aerial Seeding (**Specification 6.2**) and Restoration Enhancement Planting (**Specification 6.9**).
- C. For steep and variable mountainous terrain, helicopter application of fertilizers is the most appropriate method due to the versatility and maneuverability of the equipment. This Plan specifies the Aerial Application of Fertilizers for all SSR areas of the IA.

6.4.1.3 Coordination With Remedy.

- A. The Aerial Application of Fertilizers is specified for remedy sites designated as SSR. On these sites, fertilization as a method to enhance the quality and total cover of vegetation is not addressed in the proposed remedial action. Thus, this treatment represents an additional work item for SSR sites. As this fertilization will occur simultaneously with the Aerial Application of Hydromulch (**Specification 6.3**), this work item is specified to be implemented following slope recontouring or construction of on-slope engineering controls and pH modification via liming. Furthermore, this activity shall occur prior to revegetation plantings, such as PTSG as proposed in the Remedial Action Work Plans (AERL 2002; AERL 2001b,c,d,e,f,g,h,i,j).
- B. The Aerial Application of Fertilizers is specified to occur during the Spring of Year Eight, immediately following Aerial Seeding (**Specification 6.2**).

6.4.2 Products and Materials

6.4.2.1 Slow-Release Organic Fertilizer.

- A. The fertilizer products specified for use with this treatment shall consist of a pelletized, organic-based, slow-release fertilizer such as the product “Biosol Mix (7-2-3)” or an equivalent product with a similar long-term nutrient release rate.
- C. Fertilizers shall be applied to the specified sites at an initial rate of 1 ton/ acre. Cost estimates are based on a unit price of \$540/ ton for fertilizers. (Source: Rocky Mountain BioProducts)

6.4.2.2 Helicopter Hydromulcher.

- A. This Plan assumes that the Aerial Application of Fertilizers- Initial Rate would be implemented simultaneously along with Aerial Application of Hydromulch (**Specification 6.3**) and would utilize the same equipment as specified for that purpose.
- B. Costs for the Aerial Application of Fertilizers- Initial Rate are included in the cost provided for the Aerial Application of Hydromulch (**Specification 6.3**).

6.5 **Aerial Application of Compost-** (Steep Slope Reclamation sites, under the Intensive Restoration Alternative)

6.5.1 Scope Of Work

- 6.5.1.1 Definition. The Aerial Application of Compost refers to the broadcast application of organic compost that has been formed into lightweight pellets. Organic compost is derived from the biological decomposition of plant and organic waste materials and is typically added to disturbed soils in order to improve rootzone properties and to reintroduce the microorganisms necessary to establish healthy nutrient cycles. The Aerial Application of Compost will provide a ¼ inch layer of organic material added to the surface of selected disturbed soils within the IA. This layer of organic matter will

simulate an organic soil horizon typical of undisturbed soils and will provide long-term nutrient availability and a favorable growth media to restored vegetation.

6.5.1.2 Technical Feasibility.

- A. This treatment is specified to address the need to restore soil health and structure to disturbed areas. Proper soil structure, in this case, a structure similar to adjacent undisturbed native communities, is a prerequisite to supporting a self-sustaining cover of restored native vegetation. The addition of compost and other organic amendments (in this case, a surface application similar to mulch) to disturbed soils has been shown to provide surficial erosion resistance, reduce evaporation of soil moisture, provide favorable conditions for seed germination, and neutralize acid soils (Munshower 1994). Organic compost provides both short- and long-term benefits to newly established vegetation as it contains small quantities of nitrogen, phosphorus, and other plant nutrients. It also forms an energy source (carbon compounds) for many decomposer soil organisms such as bacteria, fungi, and other soil microbes that generate and maintain soil structure. The specified quantity of compost applied to disturbed sites is for the purposes of cost estimation and preliminary planning. Actual rates and application sites shall be determined based on soils and compost source testing prior to implementation of this treatment.
- B. Field observations and data collected on sites within the IA indicate that the Aerial Application of Compost is appropriate for sites that are inaccessible by heavy equipment and therefore will not be receiving organic matter amendments as part of the proposed remedial treatments. Specifically, such organic matter additions will address the general lack of surface litter and the large percentage of bare soils on these sites. Additionally, this treatment is compatible with other specified revegetation treatments for these sites such as Aerial Seeding (**Specification 6.2**) and Restoration Enhancement Planting (**Specification 6.10**).
- C. For steep and variable mountainous terrain, helicopter application of pelletized compost is the most appropriate method due to the versatility and maneuverability of the

equipment. This Plan specifies Aerial Compost Application by helicopters under the Intensive Restoration Alternative, for all SSR areas of the IA.

6.5.1.3 Coordination With Remedy.

- A. The Aerial Application of Compost is specified under the Intensive Restoration Alternative for SSR sites. On these sites, the surface application of compost as a method to re-establish an organic soil layer, to enhance nutrient cycling on disturbed soils, and to provide favorable conditions for establishing vegetation is not addressed in the proposed remedial action. Thus, this treatment represents an additional work item for SSR sites. This work item is specified to be implemented following slope recontouring or construction of on-slope engineering controls and pH modification via liming. Furthermore, this activity shall occur prior to revegetation plantings, such as PTSG as proposed in the Remedial Action Work Plans (AERL 2002; AERL 2001b,c,d,e,f,g,h,i,j).
- B. The Aerial Application of Compost is specified to occur during the Spring of Year Nine.

6.5.2 Products and Materials

6.5.2.1 Pelletized Compost.

- A. The compost products specified for use with this treatment shall consist of pelletized, organic compost such as the product “Planet Green” or the equivalent.
- B. Pelletized compost shall be applied to the specified sites at rate of 34 cubic yards/ acre. Cost estimates are based on a unit price of \$72.90/ cubic yard for pelletized compost. (Source: Glacier Gold)

6.5.2.2 Helicopter Broadcaster.

- A. The equipment specified for use with this treatment shall be a dry slung fertilizer or seed bucket similar to an Isolair 2600-45H or the equivalent. The seed bucket shall be suspended from a helicopter capable of supporting the bucket fully loaded (approx. 2500 lbs.).

- B. Cost estimates are based on a unit price of \$3,187.71/ acre for aerial compost application.
(Source: Minuteman Aviation)

6.6 Mechanical Compost Application/ Incorporation- (Tillage sites, under the Intensive Restoration Alternative)

6.6.1 Scope Of Work

6.6.1.1 Definition. Mechanically-applied and incorporated compost refers to the broadcast application of organic compost that is then plowed or tilled into the soil during site preparation activities. Organic compost is derived from the biological decomposition of plant and organic waste materials and is typically added to disturbed soils in order to improve rootzone properties and to reintroduce the microorganisms necessary to establish healthy nutrient cycles. Compost materials are applied to machinery-accessible, disturbed sites using modified manure spreaders or mechanical dry blowers. Since this treatment is specified for areas that will be receiving the T6 and T12 treatment, applied compost can be incorporated at the time of tillage, using the same equipment used for this purpose. The mechanical application and incorporation of compost on selected soils within the IA will help to reestablish an organic soil horizon typical of undisturbed soils and will provide long-term nutrient availability and a favorable growth media to restored vegetation.

6.6.1.2 Technical Feasibility.

- A. This treatment is specified to address the need to restore soil health and structure to disturbed areas. Proper soil structure, in this case, a structure similar to adjacent undisturbed native communities, is a prerequisite to supporting a self-sustaining cover of restored native vegetation. The addition of compost and other organic amendments to disturbed soils (in this case, incorporated into the upper soil horizon) has been shown to stimulate microflora and mycorrhizae, increase water holding capacity, increase cation exchange capacity (CEC), help aerate soils, and neutralize acid soils (Munshower 1994). Organic compost provides both short- and long-term benefits to newly established vegetation as it contains small quantities of nitrogen, phosphorus, and other plant

nutrients. It also forms an energy source (carbon compounds) for many decomposer soil organisms such as bacteria, fungi, and other soil microbes that generate and maintain soil structure.

- B. Field observations and data collected on sites within the IA indicate that Mechanical Compost Application and Incorporation is appropriate for heavy equipment accessible sites within the IA where tillage is included as part of the proposed remedial actions. Specifically, the specified treatment will address the generally poor soil conditions on these sites and will improve conditions for plants and planting.
- C. This Plan specifies Mechanical Compost Application and Incorporation under the Intensive Restoration Alternative for all T6 and T12 treatment areas of the IA. The quantity of compost applied and incorporated into selected disturbed soils within the IA is approximately equal to 25% of the soil volume. This application rate is recognized as the approximate quantity necessary to beneficially impact soil structure (Munshower 1994). The specified quantity of compost applied and incorporated into disturbed sites is for the purposes of cost estimation and preliminary planning. Actual rates and application sites shall be determined based on soils and compost source testing prior to implementation of this treatment.

6.6.1.3 Coordination With Remedy.

- A. The Mechanical Application/ Incorporation of Compost is specified under the Intensive Restoration Alternative for T6 and T12 sites. On these sites, the incorporation of compost as a method to enhance the physical characteristics of soils, to facilitate nutrient cycling on disturbed soils, and to provide favorable conditions for establishing vegetation is not addressed in the proposed remedial action. Thus, this treatment represents an additional work item for T6 and T12 sites. However, this work item can be accomplished simultaneously with, and utilizing the same equipment as, mechanical tillage treatments proposed in the Remedial Action Work Plans (AERL 2002; AERL 2001b,c,d,e,f,g,h,i,j).

- B. The Mechanical Application/ Incorporation of Compost is specified to occur during the Spring of Year One.

6.6.2 Products and Materials

6.6.2.1 Compost.

- A. The compost material specified for use with this treatment shall consist of mature organic compost such as that provided by “Big Butte Compost” or the equivalent.
- B. For areas that receive the T12 treatment, the quantity of compost applied shall be 403 cubic yards/ acre, or the equivalent of 3 inches depth across the sites to be treated prior to tilling. For areas that receive the T6 treatment, the quantity of compost applied shall be 201 cubic yards/ acre, or the equivalent of 1.5 inches depth across the sites to be treated prior to tilling. Cost estimates are based on a unit cost of \$14/ cubic yard of organic compost. (Source: Big Butte Compost)

6.6.2.2 Tillage Equipment.

- A. The equipment specified for use with this treatment shall be standard and modified agricultural implements or the equivalent.
- B. Cost estimates are based on unit prices of \$2,351/ acre for mechanical compost application and incorporation under the Active Restoration Alternative, and \$4,573/ acre for mechanical compost application and incorporation under the Intensive Restoration Alternative. (Source: Marty Farms)

6.7 **Broadcast Seeding- Enhanced Mix-** (Tillage and Vegetation Improvement sites, under the Intensive Restoration Alternative)

6.7.1 Scope Of Work

- 6.7.1.1 Definition. Broadcast Seeding refers to mechanically spreading seed evenly across the surface of the soil, as opposed to drill seeding which delivers and places the seed at a uniform depth in the soil. Broadcast seeding provides a randomly dispersed plant

community that is more like a native plant community than drill seeded planting (Munshower 1994). Broadcast seeding will be performed on sites that have previously been tilled, enabling the broadcast seed to be placed at variable depths in the soil depending upon the depth and extent of tilling. This variable depth is critical in germinating a diverse mixture of seed as each species has different light, soil depth, and moisture requirements for germination. This seeding method typically involves the use of an all-terrain vehicle or tractor outfitted with a specially designed bucket and spinner/spreader device. Seed can be combined with dry fertilizers (**Specification 6.8**) and spread in the same pass.

6.7.1.2 Technical Feasibility.

- A. The term “enhanced mix” refers to a seed mix that includes a wide variety of native forbs and grass species that are representative of the native habitat types to be restored. This enhanced mix will provide a greater diversity of species than the seed mix specified in the Remedial Action Work Plan (ARCO 2001) and will more appropriately restore disturbed areas to baseline conditions. Furthermore, establishing a more diverse community of native grasses and forbs will allow the development of a balanced plant community that includes a greater diversity of life forms. A balanced plant community includes native species that deter or impede the invasion of the site by aggressive weedy plants.
- B. Field observations and data collected on sites within the IA indicate that Broadcast Seeding of an Enhanced Mix is appropriate for all sites within the IA for which a seeding treatment is specified as part of the proposed remedial actions. Specifically, Broadcast Seeding of an Enhanced Mix will address the low native species richness and diversity resulting from reclamation seed mixes and other seeding treatments proposed under the remedial actions. Furthermore, an enhanced seed mix treatment will move these sites on a trajectory towards the restoration of baseline conditions and the distribution of native habitat types across the landscape. Refer to **Section 4** for a full discussion of these field observations and collected data.

- C. The Broadcast Seeding of an Enhanced Seed Mix is specified under the Intensive Restoration Alternative for areas that will be receiving the T6 and T12 and Vegetation Improvement (VI) treatments. These sites will be tilled and seeded as part of these remedial actions and, therefore, the addition of an enhanced seed mix represents a minimal work addition to the proposed remedial actions.

6.7.1.3 Coordination With Remedy.

- A. Broadcast Seeding of an Enhanced Seed Mix is specified under the Intensive Restoration Alternative for remedy sites designated as T6 and T12 and VI. For these sites, an herbaceous layer (grasses and forbs) with a diversity of species similar to baseline is not addressed in the proposed remedial action. This treatment is intended to supplement the seed mix proposed in the Remedial Action Work Plans (AERL 2002; AERL 2001b,c,d,e,f,g,h,i,j) and will be performed simultaneously.
- B. Broadcast Seeding of an Enhanced Mix is specified to occur during the Spring of Year Two.

6.7.2 Products and Materials

6.7.2.1 Enhanced Seed Mix.

- A. The seed mix specified for use with this treatment shall consist of native grass and forb species from an appropriate local or regional seed source. Selected species shall include dominant species representative of mid- to late-successional phases of the individual native habitat types to be restored.
- B. Native grass and forb seed shall be applied to specified sites at a rate of 4 pounds/acre. Cost estimates are based on a unit cost of \$18/ pound of native grass and forb seed. (Source: Granite Seed, WA)
- C. Typical species for inclusion in a seed mix for broadcast are as follows:

Table 6.7.2.1.1. Desirable species for enhancement of seed mix.

Grasses	
Bluebunch Wheatgrass	<i>Agropyron spicatum</i>
Pinegrass	<i>Calamagrostis rubescens</i>
Tufted Hairgrass	<i>Deschampsia cespitosa</i>
Basin Wildrye	<i>Elymus cinereus</i>
Idaho Fescue	<i>Festuca idahoensis</i>
Sheep Fescue	<i>Festuca ovina</i>
Rough Fescue	<i>Festuca scabrella</i>
Sandberg bluegrass	<i>Poa sandbergii (P. secunda)</i>
Bottlebrush Squirreltail	<i>Sitanion hystrix</i>
Forbs	
Yarrow	<i>Achillea millefolium</i>
Heart-leaved Arnica	<i>Arnica cordifolia</i>
Arrowleaf Balsamroot	<i>Balsamorhiza sagittata</i>
Fireweed	<i>Epilobium angustifolium</i>
Buckwheat	<i>Eriogonum sp.</i>
Sticky Geranium	<i>Geranium viscosissimum</i>
Blue Flax	<i>Linum lewisii</i>
Rocky Mountain Penstemon	<i>Penstemon strictus</i>
Lacy Phacelia	<i>Phacelia tenacetifolia</i>
Legumes	
Lupine	<i>Lupinus sp.</i>
American Vetch	<i>Vicia americana</i>
Hairy Vetch	<i>Vicia villosa</i>

6.7.2.2 Broadcast Seeding Equipment.

- A. The equipment specified for use with this treatment shall be a standard agricultural broadcast seeder or the equivalent.
- B. Cost estimates are based on unit prices of \$110/ acre for dry broadcast seeding. (Source: Rocky Mountain Reclamation)

6.8 Mechanical Fertilizer Application- Initial Rate- (Tillage sites)

6.8.1 Scope Of Work

6.8.1.1 Definition. The application of sustained-release, organic-based fertilizers to disturbed sites will facilitate short-term native plant establishment and growth and will regenerate the plant-soil communities and processes that sustain vegetative growth indefinitely. The specified fertilizer products are characterized by a moderate initial release of nitrogen (N) and slower long-term N release from the decomposition of organic materials and blends. The specified products are available in dry, pelletized form and are applied using an all-terrain vehicle or tractor outfitted with a specially designed bucket and spinner/spreader device. Seed (**Specification 6.7**) can be combined with dry fertilizers and spread in the same pass.

6.8.1.2 Technical Feasibility.

- A. This treatment is specified to address the regeneration of soil health and fertility in order to support (restore) a healthy stand of self-sustaining native vegetation. Disturbed sites must undergo primary succession and soil regeneration before they can support plant cover similar to adjacent vegetated areas. Studies indicate that plant growth on degraded soils is often nutrient limited, and that low soil nitrogen (N) is the most common limiting element (other than water) (Claassen and Hogan 1998). Poor soil physical characteristics can only be sustainably remediated by consistent plant growth on the site, indicating the need to apply fertilizers (supplemental N sources) to disturbed sites to support plant growth and improve soil structure. Sustained plant growth is also expected to generate secondary beneficial effects, including deposition of erosion resistant mulch layers, addition of moisture retaining soil organic matter, regeneration of pools of plant available nutrients, and the generation of water-stable soil aggregates. Soluble N amendments from standard agricultural fertilizers are incompatible with the goals of reestablishing native vegetation as these products are characterized by a rapid release of nutrients that have been shown to favor the growth of weedy annuals and exotic vegetation, to the detriment of establishing native vegetation (Claassen and Hogan 1998). The specified fertilizer products are compatible with the goals of establishing native vegetation as the

relatively lower short term N availability restricts weedy invasion while the large, organically stabilized reserve provides continued N release for multiple years.

- B. Field observations and data collected on sites within the IA indicate that fertilizer applications are appropriate for all sites within the IA for which a remedial action is proposed, including WV sites. Specifically, Mechanical Fertilizer Applications are appropriate for heavy equipment accessible sites and will address the overall lack of vegetative cover and the need to provide supplemental nutrients to facilitate the establishment of vegetation on the sites to be restored.
- C. The application of organic-based, slow-release fertilizers is specified for areas that will be receiving the T6 and T12 treatments. The treatment descriptions included in the Preliminary Design Package for RDU 3 (ARCO 2001) indicate that these sites will be fertilized following seeding. This Plan assumes that the fertilizer products used will be standard agricultural fertilizers that are described above as incompatible with the long-term goals of restoring native communities similar to baseline. Therefore, the organic-based, slow-release fertilizer products specified in this Plan are included to address these concerns. These sites will be seeded and fertilized as part of the proposed remedial actions and, therefore, the addition of organic-based, slow-release fertilizers represents a minimal work addition to the proposed treatments.

6.8.1.3 Coordination With Remedy.

- A. The Mechanical Application of Fertilizers is specified for remedy sites designated as T6 and T12. In the design alternatives specified for these sites, fertilization is addressed, however organic, slow-release fertilizers are not specified. This specification is intended as a product substitution for the remedial actions already proposed and can be implemented at the same time, and using the same equipment, as the fertilization treatments proposed in the Preliminary Design Package (AERL 2002).
- B. The Mechanical Application of Fertilizers is specified to occur during the Spring of Year Two, immediately following Broadcast Seeding (**Specification 6.7**).

6.8.2 Products and Materials

6.8.2.1 Slow-Release, Organic Fertilizer.

- A. The fertilizer products specified for use with this treatment shall consist of a pelletized, organic-based, slow-release fertilizer such as the product “Biosol Mix (7-2-3)” or an equivalent product with a similar long-term nutrient release rate.
- B. Fertilizers shall be applied to the specified sites at an initial rate of 1 ton/ acre. Cost estimates are based on a unit price of \$540/ ton for fertilizers. (Source: Rocky Mountain BioProducts)

6.8.2.2 Broadcast Fertilization Equipment.

- A. The equipment specified for use with this treatment shall be a standard agricultural dry broadcast fertilizer bucket or the equivalent.
- B. Cost estimates are based on unit prices of \$40/ acre for dry fertilizer broadcasting. (Source: Rocky Mountain Reclamation)

6.9 **Mechanical Compost Application- Surface-** (Tillage and Vegetation Improvement sites)

6.9.1 Scope Of Work

- 6.9.1.1 Definition. Mechanical Compost Application refers to the broadcast application of organic compost to serve as a top-dressing on the surface of disturbed soils. Organic compost is derived from the biological decomposition of plant and organic waste materials and is typically added to disturbed soils in order to improve rootzone properties and to reintroduce the microorganisms necessary to establish healthy nutrient cycles. Compost materials are applied to machinery-accessible, disturbed sites using modified manure spreaders or mechanical dry blowers. Compost materials are applied as a final treatment following tilling, seeding, and fertilization treatments.

6.9.1.2 Technical Feasibility.

- A. This treatment is specified to address the need to restore soil health and structure to disturbed areas. Proper soil structure, in this case, a structure similar to adjacent undisturbed native communities, is a prerequisite to supporting a self-sustaining cover of restored native vegetation. Mechanical Compost Application on selected soils within the IA will help to reestablish an organic humus or duff soil layer typical of undisturbed soils and will provide a favorable growth media and long-term nutrient availability to restored vegetation. The addition of compost and other organic amendments (in this case, a surface application similar to mulch) to disturbed soils has been shown to provide surficial erosion resistance, reduce evaporation of soil moisture, provide favorable conditions for seed germination, and neutralize acid soils (Munshower 1994). Organic compost provides both short- and long-term benefits to newly established vegetation as it contains small quantities of nitrogen, phosphorus, and other plant nutrients. It also forms an energy source (carbon compounds) for many decomposer soil organisms such as bacteria, fungi, and other soil microbes that generate and maintain soil structure.
- B. Field observations and data collected on sites within the IA indicate that Mechanical Compost Applications are appropriate for sites that are accessible by heavy equipment. Specifically, such organic matter additions will address the general lack of surface litter and the large percentage of bare soils on these sites. Additionally, this treatment is compatible with other specified revegetation treatments for these sites such as seeding and Restoration Enhancement Planting (**Specification 6.9**).
- C. This Plan specifies the mechanical surface application of compost for areas that receive the T6 and T12 and VI treatments. The quantity of compost applied to the surface of selected disturbed soils within the IA shall be a ¼ inch thick layer across all selected sites. The specified quantity of compost applied to disturbed sites is for the purposes of cost estimation and preliminary planning. Actual rates and application sites shall be determined based on soils and compost source testing prior to implementation of this treatment. The specified quantity of compost applied to disturbed sites is for the purposes of cost estimation and preliminary planning. Actual rates and application sites

shall be determined based on soils and compost source testing prior to implementation of this treatment.

6.9.1.3 Coordination With Remedy.

- A. The Mechanical Surface Application of Compost is specified for T6 and T12 and VI sites.
- B. The Mechanical Surface Application of Compost is specified to occur during the Spring of Year Two.

6.9.2 Products and Materials

6.9.2.1 Organic Compost.

- A. The compost material specified for use with this treatment shall consist of mature organic compost such as that provided by “Big Butte Compost” or the equivalent.
- B. The quantity of compost applied to the surface of selected disturbed soils within the IA shall be a ¼ inch thick layer across all selected sites. This quantity is roughly equal to 33.5 cubic yards of compost per acre. Cost estimates are based on a unit cost of \$14/ cubic yard of organic compost. (Source: Big Butte Compost)

6.9.2.2 Compost Spreader Equipment.

- A. The equipment specified for use with this treatment shall be standard agricultural compost or manure spreaders or the equivalent.
- B. Cost estimates are based on unit prices of \$374/ acre for mechanical compost application. (Source: Marty Farms)

6.10 Restoration Enhancement Planting- (all sites)

6.10.1 Scope Of Work

6.10.1.1 Definition. Restoration Enhancement Planting refers to the planting of containerized native plant materials as a component of an overall restoration strategy. This treatment is specified as a means to achieve a greater density and diversity of native woody, grass, and forb species on sites that have been previously reclaimed or that have been seeded and planted as part of the proposed remedial actions. Hand planting containerized plant materials is the preferred method of implementing Restoration Enhancement Plantings and is the most common method of planting containerized plant materials in the revegetation, reforestation, and restoration industries. A variety of restoration enhancement plantings (different planting densities and species mixes) are specified for various sites based upon the remedial action proposed, the selected Restoration Alternative (Active or Intensive), and the habitat type to be restored.

6.10.1.2 Technical Feasibility.

- A. Restoration Enhancement Planting is specified as a means to more adequately restore sites within the IA to baseline conditions. Since the revegetation treatments in the proposed remedial actions include primarily early successional and easily established reclamation species, the specified Restoration Enhancement Plantings will consist of mid- to late-successional species appropriate to the habitat types to be restored. This will be achieved by hand planting containerized woody, grass, and forb plants to augment other proposed remedial actions such as seeding and Noxious Weed Control (**Specification 6.15**). Hand planting utilizes tools such as hoedads and shovels to install plant materials in a naturalistic pattern that responds to the physical and environmental conditions of the planting site. At the time of planting, each plant will receive an additional fertilizer and compost treatment. Specifically, a fertilizer packet and a pint of pelletized compost will be incorporated into each planting hole prior to installing the seedling. Hand planting is appropriate for all sites within the IA but is especially appropriate for remote, steep, and/or inaccessible sites that preclude the use of mechanical (tractor-drawn) planters such as those used in agriculture.

- B. Field observations and data collected on sites within the IA indicate that Restoration Enhancement Planting is appropriate for all sites within the IA for which a remedial action is proposed, including WV sites. Specifically, Restoration Enhancement Plantings will address the overall lack of vegetative cover and low native species richness on the sites to be restored. Furthermore, Restoration Enhancement Plantings will move these sites on a trajectory towards the restoration of baseline conditions and distribution of native habitat types across the landscape. Refer to **Section 4** for a full discussion of these field observations and collected data.
- C. Restoration Enhancement Plantings are specified for all proposed remedy areas of the IA including T6 and T12, VI, SSR, and WV sites. Furthermore, a variety of planting densities and species mixes is specified, depending upon the proposed remedial action, the selected Restoration Alternative, and the habitat type to be restored.

6.10.1.3 Coordination With Remedy.

- A. Restoration Enhancement Planting is specified for T6 and T12 and VI sites, for which the remedial design includes soil preparation and amelioration, and seeding only. This specification represents an additional work item for these sites that is to be implemented upon the completion of the remedial actions proposed in the Remedial Action Work Plan (AERL 2002). For SSR sites, the proposed remedial action includes PTSG at a target density of approximately 500 stems/acre. This treatment seeks to increase this planting density by an additional 500 or 1000 stems/acre, depending upon the Restoration Alternative selected, and to increase the diversity of species planted. The proposed treatment can be implemented simultaneously with the proposed remedial action (PTSG) for SSR sites. For WV sites, the proposed remedial action does not include planting as a means to increase the diversity and cover of native vegetation. Thus, this treatment represents an additional work item for WV sites.

- B. Restoration Enhancement Planting is specified to occur during the Spring of Years Three through Six on the tillage, VI, and M WV areas and Spring of Years Nine through Twelve on the SSR areas.

6.10.2 Products and Materials

6.10.2.1 Containerized Plant Materials.

- A. The containerized plant materials specified for use with this treatment shall be 10 cubic inch seedlings or the equivalent size, propagated in a rigid container such as a “Super-Cell” as manufactured by Steuwe & Sons or Corvallis, OR, or the equivalent. In certain instances (e.g. grass plugs), smaller containers may be used at reduced cost but increased density. Seedlings shall be propagated from an appropriate local or regional seed source. Selected species shall include dominant species representative of mid- to late-successional phases of the individual native habitat types to be restored. Seedlings shall be hardened-off to ambient temperatures and sun exposure for a minimum of two weeks prior to planting.
- B. Under the Active Restoration Alternative, a planting density of 500 plants/acre (average 9’ spacing) is specified, consisting of mid-successional species representative of the habitat types to be restored. Cost estimates are based on a unit cost of \$1.15/ plant for containerized seedlings. (Source: Bitterroot Restoration)
- C. For the Intensive Restoration Alternative, a planting density of 1,000 plants/acre (average 6.5’ spacing) is specified, consisting of mid- to late-successional species representative of the habitat types to be restored. Cost estimates are based on a unit cost of \$1.15/ plant for containerized seedlings. (Source: Bitterroot Restoration)
- D. A list of desirable native species for Restoration Enhancement Planting on specified sites of the 1A is as follows:

Table 6.10.2.1.1. Desirable native species for Restoration Enhancement Planting.

Trees	
Douglas-fir	<i>Pseudotsuga menziesii</i>
Engelmann Spruce	<i>Picea engelmannii</i>
Limber Pine	<i>Pinus flexilis</i>
Lodgepole pine	<i>Pinus contorta</i>
Rocky Mountain Juniper	<i>Juniperus scopulorum</i>
Shrubs	
Alder	<i>Alnus sinuata</i>
Bitterbrush	<i>Purshia tridentata</i>
Chokecherry	<i>Prunus virginiana</i>
Common Juniper	<i>Juniperus communis</i>
Creeping Juniper	<i>Juniperus horizontalis</i>
Grouse Whortleberry	<i>Vaccinium scoparium</i>
Horsebrush	<i>Tetradymia canescens</i>
Oregon grape	<i>Berberis repens</i>
Russet Buffaloberry	<i>Shepherdia canadensis</i>
Scouler's Willow	<i>Salix scouleriana</i>
Serviceberry	<i>Amelanchier alnifolia</i>
Snowberry	<i>Symphoricarpos sp.</i>
Spirea	<i>Spirea betulifolia</i>
Winterfat	<i>Ceratoides lanata</i>
Wood's Rose	<i>Rosa woodsii</i>

6.10.2.2 Slow-release Fertilizer Packet.

- A. The fertilizer packet specified for use with this treatment shall consist of a slow-release fertilizer product encased in a biodegradable packet or “teabag” such as a “Bio-Pak (16-6-8+minors)” or the equivalent.
- B. One fertilizer packet shall be installed with each planted seedling. The individual packet shall be placed in the bottom of the planting hole prior to the installation of the seedling. Cost estimates are based on a unit cost of \$0.06/ packet of slow-release fertilizer.
(Source: RTI)

6.10.2.3 Pelletized Compost.

- A. The compost products specified for use with this treatment shall consist of pelletized, organic compost such as the product “Planet Green” or the equivalent.

- B. Pelletized compost shall be incorporated into the soil of each planting hole at rate of 1 pint (.000619 cubic yards)/ hole. Cost estimates are based on a unit price of \$83.70/ cubic yard for pelletized compost. (Source: Glacier Gold)

6.10.2.4 Hand Planting.

- A. The method specified for implementation of this treatment shall be hand planting using hand tools such as hoedads or the equivalent.
- B. Cost estimates are based on unit prices of \$2.98/ seedling (including amendments and plant protector installation) for hand planting. (Source: Bitterroot Restoration)

6.11 **Install Plant Protectors-** (all sites)

6.11.1 Scope Of Work

6.11.1.1 Definition. Plant Protectors are tubes constructed of rigid plastic, cardboard, or netting that are placed around a newly planted seedling in order to protect the young plants from adverse environmental conditions and/or herbivory. Plant protectors are typically left in place until the plant has become established, is climate hardy, and can tolerate a moderate level of browse (usually one or two seasons). Selection of the appropriate protection device typically depends upon site-based environmental factors, type of browse protection required, cost considerations, product life and plant growth form.

6.11.1.2 Technical Feasibility.

- A. The specified Plant Protectors will address the need for herbivory protection and microsite enhancement for all container plants installed as part of the Restoration Enhancement Planting treatment (**Specification 6.10**). Plant Protectors shelter the seedling, improve the microsite condition of the planting location, and improve growth rates (Meyer 1992, Windell 1991). Excessive herbivory of newly installed seedlings will increase plant mortality by removing large portions of actively growing stems and leaves, and can even pull the entire plant out of the ground. An appropriate protection device

will exclude grazing animals, allowing the plants to mature to a point where they have the ability to recover from a moderate level of browse. Environmental factors can also have a significant impact on seedling survival. Left unprotected, seedlings are subjected to extremes of temperature and can suffer the effects of unseasonal frost or scalding from excessive heat. Winds can prematurely dry out the seedling or, in erosion prone or bare areas, can “sandblast” the plant with windblown soils and debris. The specified products, being constructed of rigid plastic walls, also act as a miniature greenhouse, serving to trap heat, condense moisture, and even accumulate snow, which will later provide additional moisture to the establishing plant. An initial investment in Plant Protectors can lessen the need for extensive replacement plantings.

- B. Field observations and data collected on sites within the IA indicate that the Installation of Plant Protectors is appropriate for all sites within the IA for which Restoration Enhancement Planting is specified (**Specification 6.10**). Specifically, the Installation of Plant Protectors will address the inadequate to moderate number of microsites for plant establishment and the presence of light to heavy levels of browse. Refer to **Section 4** for a full discussion of these field observations and collected data.
- C. The Installation of Plant Protectors is specified for all proposed remedy areas of the IA including T6 and T12, VI, SSR, and WV sites.

6.11.1.3 Coordination With Remedy.

- A. The Installation of Plant Protectors is a companion specification to Restoration Enhancement Planting (**Specification 6.10**) and as such, is specified for T6 and T12, VI, SSR, and WV sites. The proposed remedial action for these sites does not include the addition of plant protectors on newly installed plantings (on SSR sites), although it is recommended. This Plan specifies the use of plant protectors on all plantings specified under this Plan, and does not address the addition of plant protectors for plantings proposed as part of the remedial action. This treatment represents an additional work item for SSR and WV sites.

- B. The Installation of Plant Protectors is specified to occur during the Spring of Years Three through Six on the tillage, VI, and M WV areas and Spring of Years Nine through Twelve on the SSR areas.

6.11.2 Products and Materials

6.11.2.1 Plant Protectors and Pine Stakes.

- A. The plant protectors specified for use with this treatment shall consist of a 12" tall x 4" diameter corrugated, single-wall polyethylene tube such as a "Tree-Pro Jr." or the equivalent. Each plant protector shall be fastened to a pine stake with a ratcheting plastic zip tie. The pine stake shall be driven into the soil to a depth of approximately 8-10" adjacent to the planted seedling in order to securely anchor the protector in an upright fashion. Pine stakes shall be manufactured of untreated pine, with dimensions of ¾"x ¼"x 22", and pointed on one end.
- B. One plant protector, one zip tie, and one pine stake shall be installed around each planted seedling. Cost estimates are based on a unit cost of \$0.46/ protector (including tie and stake). (Source: TreePro and Opportunity Resources)

6.11.2.2 Installation of Plant Protectors.

- A. The method specified for implementation of this treatment shall be hand labor.
- B. Cost estimates for plant protector installation are included in the cost estimate provided for Hand Planting (Specification 6.10.2.4).

6.12 Aerial Application of Fertilizers- Maintenance Rate- (Tillage, Vegetation Improvement, and Steep Slope Reclamation sites, under the Intensive Restoration Alternative)

6.12.1 Scope Of Work

- 6.12.1.1 Definition. The Aerial Application of Fertilizers at a Maintenance Rate refers to a follow up application of sustained-release, organic-based fertilizers to replenish nutrient reserves in the soil following initial establishment of restored vegetation. Repeated

application of organic-based fertilizers will effectively build nutrient resources, both short-term soluble reserves and long-term stabilized reserves, in the soil to the levels required to sustain vegetative growth indefinitely. The specified products and application methods are identical to those described for the Aerial Application of Fertilizers (**Specification 6.4**).

6.12.1.2 Technical Feasibility.

- A. This application is specified in order to increase the amounts of plant available nitrogen (N) in soils following the initial establishment of restored vegetation. The specified fertilizer products are characterized by a moderate initial release of nitrogen (N) and slower long-term N release from the decomposition of organic materials and blends. After the initial release of N has been incorporated into the plant tissues of newly established vegetation, additional N inputs are required to sustain other beneficial soil processes that are important to the effective restoration of disturbed sites (Claassen and Hogan 1998). These processes include stimulating the decomposition of litter residues, facilitating the development of extensive root systems, and supporting greater populations of soil microbes. An in-depth discussion of the benefits of fertilization is provided in **Specification 6.4**.
- B. Field observations and data collected on sites within the IA indicate that the Aerial Application of Maintenance Fertilizers is compatible with the specification for Restoration Enhancement Planting on selected sites (**Specification 6.9**). Specifically, this maintenance application will ensure the long-term survival and viability of restored vegetation and will facilitate the restoration of sustained soil fertility and nutrient cycling.
- C. The Aerial Application of Maintenance Fertilizers is specified under the Intensive Restoration Alternative for all T6 and T12, VI, and SSR sites.

6.12.1.3 Coordination With Remedy.

- A. The Aerial Application of Maintenance Fertilizers is specified under the Intensive Restoration Alternative for T6 and T12, VI, and SSR sites. On these sites, the continued

viability and enhancement of restored vegetation is not addressed through maintenance actions. Thus, this treatment represents an additional work item for these sites, and is specified to occur four years after any revegetation treatments such as seeding and planting.

- B. The Aerial Application of Maintenance Fertilizers is specified to occur during the Spring of Year Six on the tillage, VI, and M WV areas and Spring of Years Twelve on the SSR areas.

6.12.2 Products and Materials

6.12.2.1 Slow-Release, Organic Fertilizer.

- A. The fertilizer products specified for use with this treatment shall consist of a pelletized, organic-based, slow-release fertilizer such as the product “Biosol Mix (7-2-3)” or the equivalent.
- B. Fertilizers shall be applied to the specified sites at a maintenance rate of one-half ton/acre. Cost estimates are based on a unit price of \$540/ ton for fertilizers. (Source: Rocky Mountain BioProducts)

6.12.2.2 Helicopter Broadcaster.

- A. The equipment specified for use with this treatment shall be a dry slung fertilizer or seed bucket similar to an Isolair 2600-45H or the equivalent. The seed bucket shall be suspended from a helicopter capable of supporting the bucket fully loaded (approx. 2500 lbs.).
- B. Cost estimates are based on a unit price of \$177.18/ acre for aerial fertilizer application. (Source: Minuteman Aviation)

6.13 Maintenance of Plant Protectors- (all sites)

6.13.1 Scope Of Work

6.13.1.1 Definition. The Maintenance of Plant Protectors refers to the periodic readjustment or replacement of any protectors that may have been displaced or removed by environmental factors such as wind or snow loading. In addition, the Maintenance of Plant Protectors may include the removal of protectors from those plants that exhibit vigorous growth and are either inhibited by the presence of the protector, or have matured to a point where the protectors no longer provide benefit to the plant. This maintenance can be performed simultaneously with Restoration Monitoring (**Specification 6.16**) and will be an opportunity to identify the extent of plant mortality and the need for Replacement Plant Installation (**Specification 6.14**). A detailed description of Plant Protectors is presented in **Specification 6.11**.

6.13.1.1 Technical Feasibility.

- A. The use of Plant Protectors is specified to provide herbivory protection and microsite enhancement benefits to newly planted seedlings on restoration sites. A more detailed description of these benefits is provided in **Specification 6.11**. Maintenance of Plant Protectors is essential to ensure that these benefits continue to be provided to newly planted seedlings until such time as they are well established and matured to a point where they no longer require such protection.
- B. Field observations and data collected on sites within the IA indicate that the Installation of Plant Protection Devices is appropriate for all sites within the IA for which Restoration Enhancement Planting is specified (**Specification 6.10**). Similarly, the maintenance of those Plant Protectors is appropriate for these areas as well. Refer to **Section 4** for a full discussion of these field observations and collected data.
- C. Maintenance of Plant Protectors is specified for all sites where plant protection devices will be installed (**Section 6.11**) as a companion treatment to Restoration Enhancement

Planting (**Section 6.10**). This includes all proposed remedy areas of the IA including T6 and T12, VI, SSR, and WV sites.

6.13.1.3 Coordination With Remedy.

- A. The Maintenance of Plant Protectors is a companion specification to the Installation of Plant Protectors (**Specification 6.8**) and as such, is specified for all sites, including T6 and T12, VI, SSR, and WV sites. The proposed remedial action for these sites does not include the addition of plant protectors (and, likewise, the maintenance of those protectors) on newly installed plantings (on SSR sites), although it is recommended. This Plan specifies the use of plant protectors on all plantings specified under this Plan, and does not address the addition of plant protectors for plantings proposed as part of the remedial action. This treatment represents an additional work item for SSR and WV sites.
- B. The Maintenance of Plant Protectors is specified to occur during the Summer of Years Four through Eight on the tillage, VI, and M WV areas and Summer of Years Ten through Fourteen on the SSR areas.

6.13.2 Products and Materials

6.13.2.1 Plant Protectors and Pine Stakes.

- A. The plant protectors specified for use with this treatment shall consist of a 12" tall x 4" diameter corrugated, single-wall polyethylene tube such as a "Tree-Pro Jr." or the equivalent. Each plant protector shall be fastened to a pine stake with a ratcheting plastic zip tie. The pine stake shall be driven into the soil to a depth of approximately 8-10" adjacent to the planted seedling in order to securely anchor the protector in an upright fashion. Pine stakes shall be manufactured of untreated pine, with dimensions of ¼"x ¾"x 22", and pointed on one end.
- B. One plant protector, one zip tie, and one pine stake shall be installed around each planted seedling. Cost estimates are based on a unit cost of \$0.46/ protector (including tie and stake). (Source: TreePro and Opportunity Resources)

6.13.2.2 Maintenance of Plant Protectors.

- A. The method specified for implementation of this treatment shall be hand labor.
- B. Cost estimates for maintaining plant protectors are estimated as 10% of the original costs of planting and plant protector installation (**Specification 6.10.2.4**). The actual quantity of plant protectors to be maintained or replaced will be based upon the results of Restoration Monitoring (**Specification 6.16**).

6.14 **Replacement Plant Installation-** (all sites)

6.14.1 Scope Of Work

6.14.1.1 Definition. Replacement Plant Installation refers to the replanting of containerized plant materials that may have died following the initial Restoration Enhancement Planting (**Specification 6.10**) efforts and therefore failed to establish the target density and coverage of restored vegetation. Replacement Plant Installation will address any failures in restoration plantings due to environmental extremes, non-viable species selections, excessive browse, or other factors identified during Restoration Monitoring (**Section 6.16**). Replacement plantings may replicate the species mixes originally planted in order to ensure the diversity targets are met, or may be informed by the monitoring results and target those species that have been shown to establish well on these sites.

6.14.1.2 Technical Feasibility.

- A. The need for this treatment will rely upon the information gained during Restoration Monitoring efforts (**Specification 6.16**). Replacement Plant Installation will occur on specific sites as necessary in order to ensure that the restoration goals for native species diversity and density of cover are ultimately met.
- B. Field observations and data collected on sites within the IA indicate that Restoration Enhancement Planting (**Specification 6.10**) is appropriate for all sites within the IA for which a remedial action is proposed, including WV sites. The specification for

Replacement Plant Installation is a companion specification to Restoration Enhancement Planting. Specifically, Restoration Enhancement Plantings and the potential requirement for Replacement Plant Installation will address the overall lack of vegetative cover and low native species richness on the sites to be restored. Refer to **Section 4** for a full discussion of these field observations and collected data.

- C. Replacement Plant Installation is specified for all proposed remedy areas of the IA that will be receiving Restoration Enhancement Planting (**Specification 6.10**), including T6 and T12, VI, SSR, and WV sites.

6.14.1.3 Coordination With Remedy.

- A. Replacement Plant Installation is a companion specification to Restoration Enhancement Planting (**Specification 6.10**) and as such, is specified for all sites, including T6 and T12, VI, SSR, and WV sites. This treatment represents an additional work item for these sites.
- B. Replacement Plant Installation is specified to occur during the Spring of Years Four through Seven on the tillage, VI, and M WV areas and Spring of Years Ten through Thirteen on the SSR areas.

6.14.2 Products and Materials

6.14.2.1 Containerized Plant Materials.

- A. The containerized plant materials specified for use with this treatment shall be 10 cubic inch seedlings or the equivalent size, propagated in a rigid container such as a “Super-Cell” as manufactured by Steuwe & Sons or Corvallis, OR, or the equivalent. Seedlings shall be propagated from an appropriate local or regional seed source. Selected species shall include dominant species representative of mid- to late-successional phases of the individual native habitat types to be restored. Seedlings shall be hardened-off to ambient temperatures and sun exposure for a minimum of two weeks prior to planting.
- B. The total quantity and density of replacement plantings shall be based upon the results of Restoration Monitoring (**Specification 6.16**). Replacement species shall be

representative of the habitat types to be restored. Cost estimates are based on a 20% replacement of the plant quantities originally planted (**Specification 6.10.2.1**).

6.15 Noxious Weed Control- (all sites)

6.15.1 Scope Of Work

6.15.1.1 Definition. Noxious weed control refers to actions that will eliminate or reduce the influence of observed noxious weed species. Biocontrol is identified as the technique of choice for control of noxious weeds. Biocontrol is a term used to describe the use of insects or pathogens that consume the roots, stems, foliage and flower heads of the target plants as a means of controlling their populations. Several biocontrol insects and pathogens have been proven effective in Montana and are described in detail by the Montana Weed Control Association (MWCA, 2001). This Plan recognizes that effective control agents are not available for all noxious weeds and that spot application of herbicides may be a necessary addition to this treatment. Insects or pathogens specific to the target noxious weed can be purchased from biocontrol vendors. The biocontrol agents are released in established patches of noxious weeds and allowed to multiply and consume noxious weed resources. Established populations of biocontrol insects can be harvested and moved to other noxious weed infestations.

6.15.1.2 Technical Feasibility.

- A. Biocontrol is specified in order to address the need to control noxious weed species present in the IA.
- B. Field observations and data collected on sites within the IA indicate the presence of the following state-listed noxious weed species: leafy spurge, Russian knapweed, diffuse knapweed, Canada thistle, dalmation toadflax, and hoary cress. Refer to **Section 4** for a full discussion of these field observations and collected data.
- C. All sites containing state-listed noxious weeds will be treated with biocontrol.

6.15.1.3 Coordination With Remedy.

- A. Noxious Weed Control is specified for all sites on which the presence of noxious weeds has been noted, including T6 and T12, VI, SSR, and WV sites. For these sites, the use of biocontrol as a method to control the presence of noxious weeds is not addressed in the proposed remedial action. Thus, this treatment represents an additional work item for all remedial action sites.
- B. Noxious Weed Control is specified to occur during the Fall of Years Three through Seven on the tillage, VI, and M WV areas and Fall of Years Nine through Thirteen on the SSR areas.

6.15.2 Products and Materials

6.15.2.1 Spurge flea beetle (*Aphthona spp.*) combination.

- A. Three species of spurge flea beetle will be used in combination to control leafy spurge. These species are as follows: black dot spurge flea beetle (*Aphthona nigriscutis*), amber spurge flea beetle (*A. flava*), and brown-legged spurge flea beetle (*A. lacertosa*). In general, spurge flea beetle adults feed extensively on the leaves and bracts of leafy spurge. Females lay an average of 225 eggs at the base of leafy spurge plants. Developing larvae feed upon primary and secondary roots and cause considerable damage to infested plants.
- B. Five pre-packaged cartons containing approximately 1,000 spurge flea beetles each will be released per acre of leafy spurge infestation. Cost estimates are based upon a unit price of \$110/ carton of spurge flea beetles.

6.15.2.2 Spurge shoot-tip gall midge (*Spurgia esulae*).

- A. Females within this species lay eggs upon the tips of aboveground stems of leafy spurge. Developing larvae then begin feeding upon the tips of stems causing the affected plant to form galls surrounding the larvae. Gall formation effectively prevents flowering and seed production on the attacked stem, and reduces carbohydrate reserves.

- B. Two pre-packaged cartons containing approximately 500 adults each will be released per acre of leafy spurge infestation. Cost estimates are based upon a unit price of \$55/ carton of spurge shoot-tip gall midges.

6.15.2.3 Knapweed root weevil (*Cyphocleonus achates*).

- A. Females within this species lay approximately 100 eggs at the base of older knapweed plants. Developing larvae feed on the plant's central taproot, thus damaging vascular tissue and causing the formation of root galls.
- B. Two pre-packaged cartons containing approximately 100 adults each will be released per acre of knapweed infestation. Cost estimates are based upon a unit price of \$165/ carton of knapweed root weevils.

6.15.2.4 Knapweed flowerhead weevils (*Larinus spp.*).

- A. Two species of knapweed flowerhead weevils will be used in combination to control knapweed. The two species are as follows: blunt knapweed flowerhead weevil (*Larinus obtusus*) and lesser flowerhead weevil (*L. minutus*). Females within both of these species lay eggs within the flowers of knapweed plants. Developing larvae feed upon the flower heads and greatly diminish the number of seeds produced.
- B. Two pre-packaged cartons (one carton for each species) containing approximately 100 adults each will be released per acre of knapweed infestation. Cost estimates are based upon a unit price of \$110/ carton of knapweed flowerhead weevils.

6.15.2.5 Thistle stem gall fly (*Urophora cardui*).

- A. Females within this species lay eggs at the base of Canada thistle plants in early summer when plants are in the bolting phase. Developing larvae feed on shoot tissue causing the affected plant to form hard, woody stem galls surrounding the larvae. Gall formation disrupts the movement of water and nutrients within the affected stem that leads to reduced vigor and seed production.

- B. Four pre-packaged cartons containing approximately 100 adults each will be released per acre of Canada thistle infestation.

6.15.2.6 Canada thistle flower weevil (*Larinus planus*).

- A. Females within this species lay eggs in flower heads of Canada thistle plants. Developing larvae feed in the flower heads, thereby decreasing seed production. Additionally, adults within this species feed on the foliage of Canada thistle plants causing an overall decline in plant vigor.
- B. Four pre-packaged cartons containing approximately 100 adults each will be released per acre of Canada thistle infestation.

6.15.2.7 Canada thistle stem weevil (*Ceutorhynchus litura*).

- A. Females within this species deposit eggs in young shoots of Canada thistle during spring. The developing larvae then feed on, or “mine,” the inside of elongating stems during the growing season. Fully developed larvae then exit the plant near the root crown, leaving multiple exit holes and further damaging the stem tissue.
- B. Four pre-packaged cartons containing approximately 100 adults each will be released per acre of Canada thistle infestation.

6.15.2.8 Thistle defoliating beetle (*Cassida rubiginosa*).

- A. Both adults and developing larvae of this species feed extensively on Canada thistle leaf tissue throughout the spring, summer, and fall causing an overall decline in plant vigor.
- B. Four pre-packaged cartons containing approximately 100 adults each will be released per acre of Canada thistle infestation.

6.16 Restoration Monitoring- (all sites)

6.16.1 Scope Of Work

6.16.1.1 Definition. Restoration Monitoring refers to actions that will guide site management decisions and determine the effectiveness of restoration efforts. Restoration monitoring activities will include plant surveys and survival counts. Plant surveys will consist of traversing established routes across restoration treatment areas and recording the presence or absence of plant species. Plant surveys will identify weed control needs and document the development of species richness. Survival counts will occur on transects established at the time of outplanting activities. The presence and growth status of plants will be recorded and survival rates calculated in order to guide replanting efforts.

6.16.1.2 Technical Feasibility.

- A. Restoration monitoring is specified in order to guide future management of the restored area and to assess the success or failure of the project.
- B. The restoration treatments require quantitative feedback in order to determine replanting, plant maintenance, and biocontrol needs. Restoration monitoring will provide the required feedback.
- C. Representatives of the restoration units will be sampled.

6.16.1.3 Coordination With Remedy.

- A. Restoration Monitoring is specified for all sites, including T6 and T12, VI, SSR, and WV sites. This treatment represents an additional work item for these sites and is specified to occur after, and evaluate the relative success of, the proposed remedial and restorative actions.
- B. Restoration Monitoring is specified to occur during the Summer of Years Three through Eight on the Tillage, VI, M WV areas and during the Summer of Years Nine through Fourteen on the SSR areas.

6.16.2 Products and Materials

6.16.2.1 Restoration Monitoring.

A. No materials are required.

B. Costs for Restoration Monitoring are based upon an estimate of 1% of the total cost for site restoration activities.

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SECTION 7

DESCRIPTIONS OF RESTORATION SPECIES

Section 7: Descriptions of Restoration Species

The following section outlines key attributes of plants targeted for use in restoration efforts at the Stucky Ridge and Smelter Hill IA. The majority of information in this section was compiled directly from the USDA Forest Service Rocky Mountain Research Station's Fire Sciences Laboratory in Missoula, Montana. When information on a particular species was unavailable, other sources are noted.

7.1 Rocky Mountain Douglas-fir (*Pseudotsuga menziesii* var. *glauca*)

Habit. Coniferous, evergreen tree seldom exceeding 130 feet in height and 5 feet in diameter.

Associated Species. Englemann spruce, subalpine fir, limber pine, lodgepole pine, Rocky Mountain juniper, spirea, Oregon grape, common juniper, chokecherry, serviceberry, dwarf huckleberry, pinegrass, elk sedge, bluebunch wheatgrass, Idaho fescue, arrowleaf balsamroot, heart-leaved arnica.

Habitat Value. Douglas-fir habitat types provide excellent hiding and thermal cover for big game species. Mule deer, elk, and moose may browse foliage to varying degrees in the winter or early spring when other preferred forage is lacking. Small mammals such as chipmunks, mice, voles, and shrews eat large quantities of conifer (including Douglas-fir) seeds from the forest floor, and red squirrels cut great quantities of Douglas-fir cones and cache them for later use. Numerous species of songbirds extract seeds from Douglas-fir cones and forage for seeds on the ground. Douglas-fir snags are important for cavity-nesting birds. Needles are an important winter food of blue grouse.

Restoration and Erosion Control Considerations. Douglas-fir exhibits considerable genetic variation, and seed for restoration purposes should come from nearby seed sources. Seedlings will establish and grow over a wide range of aspects, slopes, landforms, and soils. Seedlings generally establish best on mineral soils or organic seedbeds of less than 2 inches and under partial shade. This species is occasionally planted for erosion control. Its erosion control potential is rated as medium in Utah, and high in Colorado and Wyoming.

Management Implication. Western spruce budworm, Douglas-fir tussock moth, and Douglas-fir beetle are the most common insect pests. Dwarf mistletoe is a serious problem in dry Douglas-fir forests. Mean fire interval for Douglas-fir forests in southwestern Montana is 40 to 45 years. Low growing branches and flammable foliage can carry ground fires into the crown.

Source: FEIS (Uchytel, Ronald J. and M. Crane. 1991)

7.2 Engelmann Spruce (*Picea engelmannii*)

Habit. Coniferous, evergreen tree reaching 160 feet in height and 40 inches in diameter in favorable sites. Height is much reduced near tree line, often forming krummholz.

Associated Species. Subalpine fir, lodgepole pine, Douglas-fir, grouse whortleberry, globe huckleberry, pinegrass, elk sedge, mountain arnica, beargrass

Habitat Value. Englemann spruce dominated forests provide excellent hiding and thermal cover for big game species. Ungulates may browse young growth when other preferred forage is lacking. Small mammals such as chipmunks, mice, and voles eat large quantities of conifer (including Englemann spruce) seeds from the forest floor, and squirrels sometimes clip and eat spruce twigs and buds. Numerous species of songbirds feed on spruce seed. Snags, particularly those over 11 inches in diameter, are important for cavity-nesting birds. Blue grouse and spruce grouse may feed extensively on buds and needles.

Restoration and Erosion Control Value. A valuable restoration species for cool, moist sites at higher elevations near tree line. Has been used successfully for long-term stabilization of high elevation mine spoils. Planting of nursery grown seedlings more successful than direct seeding, but young seedlings need protection from direct sun. Seedlings establish best on mineral soils, but a shallow duff layer may be beneficial at higher elevations to protect against high intensity rain storms and frost heaving. A very slow growing species; however, 2 to 4 foot tall open grown trees have been successfully transplanted. Species grows best in moderately deep, well-drained loamy soils derived from volcanic, sedimentary, or alluvial materials.

Management Implications. Wood-rotting fungi may attack roots and lower trunk near soil level. Spruce beetle is the most common insect pest; thrives in areas where large amounts of downed woody debris exist (due to windthrow, slash, etc.). Mean fire interval is approximately 150 years.

Source: FEIS (Uchytel, Ronald J. 1990)

7.3 Limber Pine (*Pinus flexilis*)

Habit. Slow-growing, long-lived evergreen coniferous tree rarely exceeding 50 feet in height and 6.5 feet in diameter. Grows between 4,000 to 6,000 feet elevation in Montana.

Associated species. Lodgepole pine, Douglas-fir, Rocky Mountain juniper, big sagebrush, russet buffaloberry, bitterbrush, spirea, Oregon grape, common juniper, snowberry, chokecherry, serviceberry, bluebunch wheatgrass, arrowleaf balsamroot.

Habitat Value. Seeds or “nuts” of this species are large, highly nutritious, and provide critical food for numerous bird (especially Clark’s nutcracker) and rodent species which cache seeds for later use. Other birds, small mammals, and even bears utilize these caches. Sites with limber pine provide key winter range for deer and elk, and bighorn sheep use open stands on ridges.

Restoration and Erosion Control Value. Because of its slow growth rate, this species has not been used extensively in restoration. It has been used with success for revegetation of high elevation mining disturbances in Colorado; inoculation of seedlings with ectomycorrhizae and incorporation of organic amendments in planting medium improved growth and survivability in one study. A drought-tolerant species adapted to steep, rocky, well-drained, and nutrient-poor soils. Litter accumulation and ground cover are often sparse in limber pine dominated sites; severe sheet erosion of fine soil particles is possible during high-intensity summer rain storms.

Management Implications. Highly susceptible to white pine blister rust. Can be heavily colonized and killed by dwarf mistletoe. Susceptible to invasion by mountain pine beetles, cone beetles, coneworms, and budworms. Older trees are tolerant of low intensity ground fires; mean fire interval is highly variable and depends on associated species with which it grows.

Source: FEIS (Johnson, Kathleen A. 2001)

7.4 Lodgepole Pine (*Pinus contorta*)

Habit. Short-lived, evergreen, coniferous tree ranging in height from 50 to 100 feet, and having diameters of 7 to 13 inches. Grows between 4,000 to 7,500 feet elevation in Montana.

Associated species. Subalpine fir, Engelmann spruce, Douglas-fir, grouse whortleberry, globe huckleberry, spirea, Oregon grape, common juniper, snowberry, chokecherry, serviceberry, pinegrass, elk sedge, bluebunch wheatgrass, Idaho fescue, beargrass.

Habitat Value. Provides good thermal and hiding cover for deer, elk, moose, and bear. Ungulates may browse foliage, but only when more palatable forage is lacking. Seeds are an important food of pine squirrels; chipmunks and numerous songbirds also consume the seeds. Needles serve as an important winter food source for blue grouse and spruce grouse.

Restoration and Erosion Control Value. Because this species can tolerate a broad range of temperature and moisture regimes, it is used extensively in reclamation and reforestation projects in montane and subalpine ecosystems. Trees can be established either by direct seeding or planting of container grown plants. Seedlings establish best on mineral soils of a medium texture, but are weak competitors and establishment is reduced in the presence of grasses. To avoid “dog-hair” stands, stocking rates should not exceed 500 to 800 stems per acre 5 to 20 years following planting.

Management Implications. Natural regeneration by seed occurs following high intensity crown fires which releases seed from serotinous cones; low intensity ground fires do not generate enough heat to release seed. The interval between stand replacing fires in lodgepole pine forests in the northern Rockies varies widely (from 75 to 300 years) and depends on litter accumulation, insect/disease outbreaks, and mean annual precipitation. Mountain pine beetle is the most serious insect pest, and dwarf mistletoe can be problematic.

Source: FEIS (Uchytel, Ronald J. 1992)

7.5 Rocky Mountain Juniper (*Juniperus scopulorum*)

Habit. Slow-growing, long-lived, evergreen, coniferous, erect shrub or small tree that grows up to 20 to 50 feet in height and 15 inches in diameter. Grows between 5,500 to 6,500 feet elevation in Montana.

Associated species. Douglas-fir, limber pine, lodgepole pine, big sagebrush, russet buffaloberry, bitterbrush, spirea, Oregon grape, common juniper, snowberry, chokecherry, serviceberry, bluebunch wheatgrass, Idaho fescue, arrowleaf balsamroot.

Habitat Value. Provides thermal and hiding cover for deer, elk, bighorn sheep, and antelope; also provides limited browse for these species when more palatable forage is lacking. The “berries” are readily consumed by migratory birds, turkeys and other game birds, and small mammals.

Restoration and Erosion Control Value. A drought-tolerant species adapted to steep, rocky, well-drained, and nutrient-poor soils. Litter accumulation and ground cover are often sparse in limber pine dominated sites; severe sheet erosion of fine soil particles is possible during high-intensity summer rain storms.

Management Implications. Highly susceptible to white pine blister rust. Can be heavily colonized and killed by dwarf mistletoe. Susceptible to invasion by mountain pine beetles, cone beetles, coneworms, and budworms. Older trees are tolerant of low intensity ground fires; mean fire interval is highly variable and depends on associated species with which it grows.

Source: FEIS (Johnson, Kathleen A. 2001)

7.6 Antelope Bitterbrush (*Purshia tridentata*)

Habit. Long-lived, multistemmed, decumbent, evergreen shrub that may reach 12 to 15 feet, but more commonly grows to 3 to 4 feet in height. Typically found between 5,500 to 6,500 feet in elevation in southwestern Montana.

Associated species. Douglas-fir, Rocky Mountain juniper, limber pine, lodgepole pine, big sagebrush, russet buffaloberry, spirea, Oregon grape, common juniper, snowberry, chokecherry, serviceberry, bluebunch wheatgrass, arrowleaf balsamroot.

Habitat Value. Used extensively as browse by pronghorn antelope, elk, bighorn sheep, and moose in all seasons; may serve as critical browse in winter for mule deer. Seed is a large part of the diet of several rodent species, and rodents may cache large amounts of seed in a given year. May serve as important cover for sage grouse and Lewis' woodpeckers.

Restoration and Erosion Control Value. Has been used successfully in mineland reclamation projects, including reclamation of acidic mine wastes. Some ecotypes have nitrogen fixing root nodules as a result of a symbiotic association with *Frankia spp.* actinomycetes. Degree of nodulation depends on site conditions, such as soil moisture content and salinity, and available nitrogen. Establishment of seedlings via broadcast or drill seeding is generally poor, whereas planting of container-grown stock typically ensures greater seedling establishment. Species exhibits considerable genetic variation, and seed for restoration purposes should come from nearby seed sources. Tolerates a wide variety of soils, with coarse textured soils generally best; does not, however, tolerate saline soils.

Management Implications. Species is moderately to highly browse tolerant. Browsing by ungulates may help to maintain stands in a seral stage and increase shrub vigor. Young seedlings do not compete well with weedy species, especially cheatgrass. Highly susceptible to fire kill, but some ecotypes sprout after fire.

Source: FEIS (Zlatnik, Elena. 1999)

7.7 Common Chokecherry (*Prunus virginiana*)

Habit. Deciduous, thicket-forming erect shrub or small tree ranging in height from 5 to 30 feet. Typically grows between 5,500 and 7,000 feet in elevation in southwestern Montana.

Associated species. Douglas-fir, Rocky Mountain juniper, limber pine, lodgepole pine, big sagebrush, bitterbrush, russet buffaloberry, spirea, Oregon grape, common juniper, snowberry, serviceberry, bluebunch wheatgrass, arrowleaf balsamroot.

Habitat Value. Large mammals including bear, moose, coyote, bighorn sheep, pronghorn antelope, deer and elk utilize this species for browse and cover throughout the year. Small mammals and, especially, bird species feed heavily on ripened fruits and utilized plants for cover. Excellent shrub species for providing thermal cover and erosion control in fisheries.

Restoration and Erosion Control Value. Has been used for wildlife enhancement, mineland reclamation, and soil stabilization. Container-grown seedlings can be propagated from seed or rhizome cuttings, and establish well if competition from grasses, forbs, and/or weedy species is reduced near the plant. Grows in a wide variety of soil types and can tolerate weakly saline soils; however, is intolerant of poor drainage and prolonged flooding.

Management Implications. Species is moderately browse tolerant, but heavy browsing may negatively impact populations. Resprouts rapidly and prolifically following fire.

Source: FEIS (Johnson, Kathleen A. 2000)

7.8 Common Juniper (*Juniperus communis*)

Habit. Coniferous, evergreen, often mat-forming shrub growing up to 5 feet in height. Typically found between 5,500 to 7,000 feet in elevation in southwestern Montana.

Associated species. Douglas-fir, Rocky Mountain juniper, limber pine, lodgepole pine, big sagebrush, russet buffaloberry, spirea, Oregon grape, common juniper, snowberry, chokecherry, serviceberry, globe huckleberry, grouse whortleberry, bluebunch wheatgrass, arrowleaf balsamroot.

Habitat Value. Ungulates may browse sparingly during the late winter or early spring if other more palatable forage is unavailable. Serves as cover for small mammals and bird species. Birds, especially American robin and black-capped chickadee, feed on cones whenever available.

Restoration and Erosion Control Value. Because of low, mat-forming habit, this species is moderately to highly useful for erosion control once established. Planting of container grown or bare root seedlings are the most practical method for reestablishing plants. Germination and establishment of seedlings, however, is rated as difficult. Difficulty of seed germination is partly due to a thick seedcoat, a dormant embryo, and low viability of seed from older plants. The passing of seed through the digestive system of animals may enhance germination. Stem cuttings have the ability to root and may serve as another option for propagation.

Management Implications. This species may increase in density and cover in the presence of moderate to heavy grazing. Often reaches its maximum abundance on harsh, open sites. Foliage is resinous and highly flammable and plants do not resprout following fire.

Source: FEIS (Tirmenstein, D. 1999)

7.9 Oregon Grape (*Berberis repens*)

Habit. Evergreen, perennial, rhizomatous shrub with a low or prostrate growth form. Typically found between 5,500 to 7,000 feet in elevation in southwestern Montana.

Associated species. Douglas-fir, Rocky Mountain juniper, limber pine, lodgepole pine, big sagebrush, russet buffaloberry, spirea, Oregon grape, common juniper, snowberry, chokecherry, serviceberry, bluebunch wheatgrass, arrowleaf balsamroot.

Habitat Value. Fruits are eaten by a number of bird and mammal species, including black bears. Ungulates rarely browse this plant, but mule deer in Montana readily utilize browse in the fall and winter months.

Restoration and Erosion Control Value. Because it is an evergreen, rhizomatous ground cover that is both heat and drought tolerant, this plant has been suggested for use in the revegetation of rangelands, mines, roadsides, and recreational areas. Container grown plants can be propagated by seeds, suckers, cuttings, and layering. Can also be direct seeded; seeds need no pretreatment if seeded in the fall, but require cold stratification if sown in the spring. Grows best on sandy loams to silts, and in western Montana is often found on limestone soils and rarely occurs on granitic or quartzite soils.

Management Implications. Serves as an alternate host for black stem rust, a serious pathogen of cereal crops. Grows well in both shaded and open environments, and is one of the most resistant evergreen shrub species to winter sun scald. Top growth is killed during fire, but plants resprout from dormant buds on rhizomes.

Source: FEIS (Walkup, Crystal J. 1991)

7.10 Russet Buffaloberry (*Shepherdia canadensis*)

Habit. Deciduous, nitrogen-fixing shrub ranging in height from 3 to 13 feet. Typically found between 5,500 to 6,500 feet in elevation in southwestern Montana.

Associated species. Douglas-fir, Rocky Mountain juniper, limber pine, lodgepole pine, big sagebrush, russet buffaloberry, spirea, Oregon grape, common juniper, snowberry, chokecherry, serviceberry, bluebunch wheatgrass, arrowleaf balsamroot.

Habitat Value. Provides low to moderate amounts of browse for ungulates and small mammals. Berries, which ripen mid- to late-summer, are used extensively by numerous wildlife species, especially black bear, grizzly bear, and grouse. Provides good cover for bird species, but only poor to fair cover for ungulates and small mammals.

Restoration and Erosion Control Value. Because of its nitrogen-fixing ability (due to a symbiotic association with *Frankia spp.* actinomycetes), it is useful for the revegetation of disturbed land. Has been used successfully for mineland reclamation in Idaho. Planting of container-grown stock is the best method of reestablishing this species. Germination from seed is often low, highly erratic, or delayed (stratification and/or scarification treatments may improve germination). Vegetative propagation of this species is possible from root cuttings. Generally most abundant of sandy, gravelly, or rocky soils, and often thrives on nutrient-poor soils.

Management Implications. Top growth is killed during fires, but plants will resprout from the root crown or dormant buds on roots. This species is not an aggressive resprouter, however, and may take longer than other resprouting shrubs to regenerate following fire.

Source: FEIS (Walkup, Crystal J. 1991)

7.11 Serviceberry (*Amelanchier alnifolia*)

Habit. Deciduous shrub or small tree reaching 3 to 25 feet in height, and often forming thickets. Typically found between 5,500 to 7,000 feet in elevation in southwestern Montana.

Associated species. Douglas-fir, Rocky Mountain juniper, limber pine, lodgepole pine, big sagebrush, russet buffaloberry, spirea, Oregon grape, common juniper, snowberry, chokecherry, bluebunch wheatgrass, arrowleaf balsamroot.

Habitat Value. Twigs and foliage serve as valuable browse for ungulates primarily in the winter and spring. Although highly palatable, large amounts of or a diet consisting heavily or solely on this species can be fatal to mule deer. Grouse and other upland game bird species consume the fruits and buds, and several species of songbirds and rodents eat the fruits.

Restoration and Erosion Control Value. This species has been used for mineland reclamation and for wildlife and watershed enhancement projects. Container grown plants can be established for either seed or vegetative cuttings. Established plants have a large rootcrown, horizontal and vertical rhizomes, and an overall extensive root system. Grows in a broad range of habitat and soil types, but is generally not tolerant of prolonged drought.

Management Implications. Good seed crops may only be produced in 3 out of every 5 years, on average, due to drought, spring frost, or juniper rust. Intolerant of deep shade and declines quickly with canopy closure. Fire kills top growth, but the presence of both shallow and deeply buried rhizomes allows plants to resprout after light to high intensity fires.

Source: FEIS (Hickerson, Jody. 1986)

7.12 Snowberry (*Symphoricarpos albus*)

Habit. Deciduous , densely branched, rhizomatous shrub ranging from 3 to 5 feet in height. Typically found between 5,500 to 7,000 feet in elevation in southwestern Montana.

Associated species. Douglas-fir, Rocky Mountain juniper, limber pine, lodgepole pine, big sagebrush, russet buffaloberry, spirea, Oregon grape, common juniper, chokecherry, serviceberry, dwarf huckleberry, bluebunch wheatgrass, arrowleaf balsamroot.

Habitat Value. Reports in the literature vary, but this species is generally an important source of browse and food for ungulates and large mammals, such as grizzly bear. Serves as cover and food for several bird species (namely grouse, kingbird, and western flycatcher) and rodent species.

Restoration and Erosion Control Value. Widely used in the restoration of disturbed sites, including mining disturbances and degraded stream banks. Because of its rhizomatous growth habit, it possesses excellent bank stability and erosion control properties. Container grown plants can be started from seed or vegetative cuttings. Seedling establishment in the field is rated as fair, but once established, survival is high. Occurs on a wide variety of soils, is tolerant of mildly acidic to moderately alkaline conditions, and is somewhat tolerant of saline conditions. Often grows best on well-drained soils of limestone origin.

Management Implications. Often forms low growing thickets which can provide shade for the germination and establishment of other species, especially conifers. Top growth is killed by fires, but quickly resprouts from rhizomes.

Source: FEIS (McWilliams, Jack. 2000)

7.13 Spirea (*Spirea betulifolia*)

Habit. Deciduous, rhizomatous shrub ranging from 1 to 3 feet in height. Typically found between 5,500 to 7,000 feet in elevation in southwestern Montana.

Associated species. Douglas-fir, Rocky Mountain juniper, limber pine, lodgepole pine, big sagebrush, russet buffaloberry, spirea, Oregon grape, common juniper, chokecherry, serviceberry, globe huckleberry, grouse whortleberry, bluebunch wheatgrass, arrowleaf balsamroot.

Habitat Value. Overall, this species provides poor forage and cover resources for all classes of wildlife.

Restoration and Erosion Control Value. This species has not been used extensively for restoration purposes. Container grown plants can be started either from seed or vegetative cuttings, but are slow to establish in the field, often requiring 3 years to fully establish. This species, however, has been rated as medium for soil erosion reduction potential in southwestern Montana due to its moderately aggressive growth, once established. Often found on dry, rocky sites, but will also grow well in more moist sites near riparian areas or at higher elevations.

Management Implications. Because it is not a preferred forage species, spirea may be a good choice for the restoration of disturbed sites in drier montane forests. It is not a shade tolerant species, and will give way to other more shade tolerant species following forest canopy closure. Often regenerates quickly following disturbances such as fire.

Source: FEIS (Habeck, R. J. 1991)

7.14 Wood's Rose (*Rosa woodsii*)

Habit. Fast-growing, rhizomatous shrub ranging in height from 1.5 to 6 feet. Typically does not grow above 6,500 feet elevation in Montana.

Associated species. Snowberry, chokecherry, hawthorn, serviceberry, big sagebrush, willow, quaking aspen, beardless wildrye.

Habitat Value. Browsed by ungulates from spring through fall, with most use occurring in early spring when new leaves emerge. Fruits, or "rose hips," persist on the plant through much of the winter and are readily eaten by numerous bird species, wintering mule deer, and squirrels. Coyote and bear have also been reported to feed on the fruit. Thickets of this species along riparian corridors provide fair to good cover for many bird and small mammal species.

Restoration and Erosion Control Value. Used extensively for erosion control and wildlife habitat enhancement in mineland, roadcut, and riparian restoration projects. Plants can be established in the field through installation of container grown stock or hardwood cuttings, and by direct seeding. Typically found in riparian corridors, on dry grassy slopes, and in disturbed areas (such as road cuts and cut slopes) throughout the Rockies. Grows on a wide variety of soils, but typically prefers moist, well-drained soils associated with riparian areas. Will also tolerate moderately acidic to mildly basic soils.

Management Implications. Has a fairly high tolerance to browsing. Can be potentially affected by a number of insect and disease pests. Top growth is killed by fire, but can resprout from buried rhizomes following low to moderate severity fires.

Source: FEIS (Tesky, Julie L. 1992)

7.15 Great Basin Wildrye (*Leymus cinereus*)

Habit. Robust, cool-season, perennial bunchgrass that ranges in height from 3 to 6 feet. Typically found between 3,200 and 6,700 feet in Montana.

Associated species. Big sagebrush.

Habitat Value. Forage is very coarse after maturity and is generally considered inferior. Provides elk, however, with spring, fall, and winter forage. Stands can provide cover and bedding areas for deer, birds, and small mammals. Bird and rodent species also utilize the seeds for food.

Restoration and Erosion Control Value. Not used extensively in the past due to poor germination and seedling vigor. Improved cultivars have been developed ('Magnar' and 'Trailhead') which overcome these problems. The use of these cultivars for the revegetation of disturbed sites with saline and/or alkaline soils is recommended. This species is also recommended for riparian restoration in mountain-brush and mountain big sagebrush communities where annual precipitation is greater than 10 inches. When using seed from improved cultivars in seed mixtures, the seeding rate of this species should be lowered as seedlings can be quite competitive and may suppress other species. This species exhibits a great deal of genetic variation among populations; the use of a local seed source or seed from improved cultivars adapted to local conditions is highly recommended. If the use of local seed is preferred over seed from cultivars, outplanting with container grown seedlings (as opposed to direct seeding with local seed) is a viable option.

Management Implications. Susceptible to damage from spring grazing or frequent cutting during the growing season. Research has indicated that spring grazing should be withheld until new growth reaches at least 10 inches and remaining stubble should not be less than 6 inches. Generally survives fire to become part of the early seral post-fire community.

Source: FEIS (McMurray, N. 1987)

7.16 Bluebunch wheatgrass (*Pseudoroegneria spicata*)

Habit. Drought-resistant, perennial, cool-season grass with densely tufted culms that reaches 12 to 30 inches in height. Typically found between 5,000 and 7,500 feet in Montana.

Associated species. Douglas-fir, englemann spruce, limber pine, lodgepole pine, Rocky Mountain juniper, spirea, Oregon grape, common juniper, chokecherry, serviceberry, Idaho fescue, rough fescue, arrowleaf balsamroot.

Habitat Value. Considered one of the most important forage species for wildlife on western rangelands. Elk, mule deer, bison, and bighorn sheep, in particular, make high use of this species during the winter months. Rough fescue/bluebunch wheatgrass habitat types may provide suitable cover for ground-nesting birds.

Restoration and Erosion Control Value. Used extensively for the restoration of mine- and rangelands. Reports in the literature vary, but may be difficult to establish from seed and have low seedling vigor. Once established, however, plants develop an extensive root system, are extremely drought tolerant, and are an excellent choice for soil stabilization. Improved cultivars for this species and beardless bluebunch wheatgrass (*P. spicata* ssp. *inermis*) have been developed that have high germination rates and seedling vigor. This species requires well-drained soils and will not tolerate excessively saline soil conditions.

Management Implications. Plants are extremely sensitive to defoliation during active growth, but are moderately grazing tolerant during the non-growing period. Does not compete well with introduced and/or weedy species such as spotted knapweed, cheatgrass, and crested wheatgrass. Plants generally tolerate fire and will resprout following fire. Mean fire intervals for bluebunch wheatgrass habitat types are highly variable, but are generally under 30 years.

Source: FEIS (Zlatnik, Elena. 1999)

7.17 Bottlebrush Squirreltail (*Sitanion hystrix*)

Habit. Drought-resistant, perennial, cool-season grass 12 to 18 inches in height. Typically found throughout a broad elevation range in Montana.

Associated species. No information.

Habitat Value. Overall, use of this species by wildlife is generally low, but forage may be utilized by ungulates and small mammals mostly during winter and spring months.

Restoration and Erosion Control Value. Widely used for restoration throughout the West due to its ability to colonize disturbed sites. In particular, this species is recommended for use in the restoration of pinyon-juniper, sagebrush, and lodgepole pine communities. Bottlebrush squirreltail inhabits a wide variety of soil types, and, throughout Montana, it occurs predominantly on dry, gravelly soils, in saline or alkaline areas. This species competes well with, and can invade areas dominated by, such weedy species as cheatgrass, medusahead, and Japanese brome. A great deal of ecotypic or genetic variation exists within this species; seed used for restoration projects should come from local seed sources or from appropriate improved cultivars.

Management Implications. Tolerant of light to moderate grazing, but long, sharp awns develop on inflorescences in late spring through summer that may cause injury to the eyes, nostrils, and mouths of grazing animals. Also tolerant of fire, and is found in the early seral, post-fire plant communities of numerous habitat types, either establishing from on- or off-site seed, or resprouting from existing rootcrowns.

Source: FEIS (Simonin, Kevin A. 2001)

7.18 Sandberg Bluegrass (*Poa secunda*)

Habit. Shallow-rooted, short-lived, cool-season, perennial bunchgrass 6 to 18 inches in height. Typically found throughout a broad elevation range in Montana.

Associated species. No information.

Habitat Value. One of the first grass species to green up in the early spring, but usually goes dormant by early summer. Provides fair to good forage for elk and mule deer in Montana. Small mammal species, such as ground squirrels, may utilize forage, as well.

Restoration and Erosion Control Value. Used extensively throughout the West, especially for mineland reclamation. This species occurs on flats and ridgetops, slopes, meadows, and open timberline. It grows well in rich clay loam soils, but most often inhabits shallow, rocky, or sandy soils. This species is very drought tolerant.

Management Implications. Tolerant of moderate to heavy grazing, but stands generally produce low amounts of forage, compared to other grass species. Although drought tolerant, this species produces very little forage in drought years, and is not a dependable forage species during dry years. This species is generally unharmed by fire because it produces little litter, and its small bunch size and sparse litter reduces the amount of heat transferred to perennating buds in the soil. Its rapid maturation in the spring also reduces fire damage, since it is dormant when most fires occur. Cover often increases when interference from other species is reduced by fire.

Source: FEIS (Bradley, Anne. 1986; Howard, Janet L. 1997)

7.19 Idaho Fescue (*Festuca idahoensis*)

Habit. Long-lived, cool season, perennial bunchgrass that forms dense clumps and grows from 1 to 3 feet in height. Typically found from 5,000 to 7,500 feet in southwestern Montana

Associated species. Douglas-fir, englemann spruce, limber pine, lodgepole pine, Rocky Mountain juniper, spirea, Oregon grape, common juniper, chokecherry, serviceberry, bluebunch wheatgrass, rough fescue, prairie junegrass, western needlegrass, arrowleaf balsamroot, yarrow.

Habitat Value. The Idaho fescue/bluebunch wheatgrass habitat type in southwestern Montana is widely used by big game animals. Elk and deer use the type as low-elevation winter range, and pronghorn use it year-round. At intermediate elevations Idaho fescue is important spring-fall range, and at upper elevations it provides summer range for elk and mule deer. This species may be included in the diets of northern pocket gophers and grizzly bears, and is a common understory component of grouse habitat in Montana.

Restoration and Erosion Control Value. Idaho fescue is slow to establish, but once established, has abundant growth of fine leaves that provide effective ground cover, and high yields of tough, fine, fibrous roots that control erosion and improve soil structure. It grows on a wide variety of soils types, but generally has a poor tolerance to salinity. The presence of competitive non-native species such as cheatgrass and spotted knapweed may inhibit the growth and establishment of this species, but once Idaho fescue is established, it can resist the invasion of non-native species. A great deal of ecotypic or genetic variation exists within this species; seed used for restoration projects should come from local seed sources or from appropriate improved cultivars.

Management Implications. This species is generally favored by light to moderate grazing, but often decreases in cover and abundance under heavy grazing. Plants are not harmed by light severity fires, and typically reestablish through rapid tillering or from seed.

Source: FEIS (Zouhar, Kristin L. 2000).

7.20 Rough Fescue (*Festuca scabrella*)

Habit. Long-lived, cool season, perennial bunchgrass that forms dense clumps and grows from 1 to 3 feet in height. Typically found in foothills, mountains to near timberline, benchlands and valleys. Most abundant on dry, deep sandy loam soils.

Associated species. Bluebunch wheatgrass, Idaho fescue, western needlegrass, arrowleaf balsamroot, prairie sage.

Habitat Value. Good forage value for wildlife during all growth stages. Valuable for winter grazing because it retains much of its protein and palatability.

Restoration and Erosion Control Value. No information is available, but assumed to be similar to Idaho fescue. Rough fescue will likely be slow to establish, but once established, will have abundant growth of fine leaves that provide effective ground cover, and high yields of tough, fine, fibrous roots that control erosion and improve soil structure. The presence of competitive non-native species such as cheatgrass and spotted knapweed may inhibit the growth and establishment of this species, but once established, it will resist the invasion of non-native species.

Management Implications. This species is generally favored by light to moderate grazing, but often decreases in cover and abundance under heavy grazing. Plants are not harmed by light severity fires, and typically reestablish through rapid tillering or from seed.

Sources: Stubbendieck, J. S.L. Hatch, and C.H. Butterfield 1992.

7.21 Sheep Fescue (*Festuca ovina*)

Habit. Perennial, cool season bunchgrass ranging from six to twenty-four inches in height.

Associated species. Idaho fescue, rabbitbrush, big sagebrush.

Habitat Value. Valuable forage grass for all classes of livestock. It is one of the first grasses to green in the spring. No reference to wildlife browse value, but assumed good.

Restoration and Erosion Control Considerations. Commonly used for soil erosion control, pasture, turf, watershed protection, roadside beautification, airports, dams sites, terraces, diversions, ditchbanks, mine spoils, and ski slope revegetation.

Management Implication. While resistant to drought and trampling, the absence of underground stems and lack of a strong reproduction from seed make it susceptible to overgrazing.

Source: USDA 1988.

7.22 Tufted Hairgrass (*Deschampsia cespitosa*)

Habit. Tufted hairgrass is a perennial, cool season bunchgrass found in the mountains in all of the Western States and is one of the most widely distributed of the western range grasses.

Associated Species. None listed.

Habitat Value. Tufted hairgrass is considered high quality forage for all classes of livestock.

Restoration/ Erosion Control Value. No specific information was available on the erosion control value of this species. It is noted, however, to form pure stands with almost complete ground cover on favorable sites. In addition, it has been noted as being highly tolerant to metal-contaminated soils. Also, it is adapted to a wide range of soil types.

Management Implications. New plants are established entirely from seed. Grazing practices should allow for seed to mature to ensure the sustainability of a stand.

Source: USDA 1988.

7.23 Balsamroot (*Balsamorhiza sagittata*)

Habit. Deep-rooted perennial forb common to the Intermountain West.

Associated Species. Arrowleaf balsamroot is a climax indicator in several sagebrush and grassland habitat types. It commonly grows in mixed stands with grasses, other forbs, and shrubs.

Habitat Value. Arrowleaf balsamroot provides some degree of forage for cattle, sheep, horses, pronghorn, bighorn sheep, and mule deer. On spring ranges, it is an important and palatable forage because it greens up early. Flowering heads are often preferred over the foliage. Arrowleaf balsamroot is utilized year-round but is more palatable during spring and early summer when the foliage is succulent.

Restoration and Erosion Control Considerations. Arrowleaf balsamroot is rated as having high potential for revegetation of oil shale or coal mined land, and stabilization of roadsides and other critical areas. In the Intermountain region it has only low value for soil stabilization.

Seed of arrowleaf balsamroot can be broadcast or drilled. However, because arrowleaf balsamroot is very slow growing, drilling is recommended to separate it from more competitive species. The seedbed should be firm, and the seeds should be covered after planting. Fall or winter seeding is recommended.

Seedlings of arrowleaf balsamroot are persistent on adapted sites. Seeds from a similar source should be used due to regional variation in cold tolerance.

Management implications. Following seeding, sites should not be grazed for at least two growing seasons. Establishment may take 5 to 10 years. On the best sites, plants may require 3 to 4 years to flower, and 7 to 8 years on more arid sites. When established, arrowleaf balsamroot is competitive and compatible with other species.

Source: FEIS: Fischer, William C.; Holifield, J. L. 1987.

7.24 Fireweed (*Epilobium angustifolium*)

Habit. Perennial warm season forb from one to six feet in height. Generally found in open woods, roadsides, disturbed areas in a broad range of soil types. Very abundant following fire.

Associated Species. None listed.

Habitat Value. Fireweed is utilized as browse by moose, deer and elk. In the Rocky Mountains, fireweed is an important food for elk in summer and elk sometimes feed exclusively on it. Small mammals, such as chipmunks and pikas, eat fireweed seeds. Fireweed is a nectar source for hummingbirds. Butterflies use both the nectar and pollen from fireweed.

Restoration and Erosion Control Value. Fireweed is used for revegetation of mined land and has the ability to voluntarily seed into sites when a seed source is available. Fireweed is recommended for use as protective groundcover on disturbed sites, such as roadways and logged areas. Planting fireweed rhizomes may speed colonization of a disturbed area. Dormant rhizomes have been collected and planted in simulated pipeline trenches and road rights-of-way in the Northwest Territories.

Management Implications. Fireweed is an important colonizer following vegetation disturbances in temperate climates worldwide. Fireweed enters a disturbed community and rapidly becomes abundant. In 20 study sites in Montana, it has been reported that fireweed established with about 3 percent cover 1 year after disturbance. By the second year, it peaked at about 30 percent cover and stayed around this amount for the next 8 years. Fireweed populations can maintain themselves through vegetative reproduction if conditions are not conducive to flowering.

Source: FEIS: Diane S. Pavsek, December 1992.

7.25 Flax (*Linum lewisii*)

Habit. Short-lived perennial forb common to the Intermountain West.

Associated Species. None listed.

Habitat Value. Flax is considered desirable forages for deer, antelope and birds either as herbage or seed. Flax is noted to have fair forage value for livestock and wildlife during spring and winter. Birds use the seed and capsules in fall and winter. They may also provide some cover for selected small bird species.

Restoration and Erosion Control Value. Flax species are noted for their value in mixes for erosion control and beautification values.

Management Implications. None listed.

Source: USDA 1988.

7.26 Hairy Vetch (*Vicia villosa*)

Habit. Cool season, short-lived perennial legume.

Associated Species. None listed.

Habitat Value. Vetch provides excellent forage for livestock and wildlife. Mule deer, black bear, and grizzly bear browse the leaves and flowers. American vetch also provides forage for game birds and small mammals.

Restoration and Erosion Control Value. It is also useful for revegetating coal-mined lands, roadsides, and in critical-site stabilization and beautification sites. Vetch has been successfully planted in disturbed alpine rangelands in the western United States.

Management Implications. None listed.

Source: USDA 1988.

7.27 Lupine (*Lupinus argenteus*)

Habit. Perennial legume common throughout the West.

Associated Species. None listed.

Habitat Value. Lupine has been noted as being poisonous to livestock, primarily sheep and, to a lesser degree, cattle. The seeds and pods, and in some cases young plants, may sicken livestock or, in the case of heavy utilization, can prove fatal. Lupines do furnish fairly good forage for elk.

Restoration and Erosion Control Value. Lupines are valued primarily for their ability to fix nitrogen, enhancing the fertility of the soils they inhabit.

Management Implications. None listed.

Source: USDA 1988.

7.28 Lacy Phacelia (*Phacelia tanacetifolia*)

Habit. A low growing annual forb common to disturbed sites.

Associated Species. None listed.

Habitat Value. None listed.

Restoration and Erosion Control Value. Aggressive annual, adapted to a wide range of soils. Used for stabilization or beautification of disturbed sites.

Management Implications. None listed.

Source: Granite Seed, 2000

7.29 Rocky Mountain Penstemon (*Penstemon strictus*)

Habit. Perennial forb common to disturbed sites.

Associated Species. None listed.

Habitat Value. Penstemons are considered forage for deer, antelope and birds either as herbage or seed. They may also provide some cover for selected small bird species. They provide diversity to the plant community.

Restoration and Erosion Control Value. Capable of establishing on disturbed sites on a variety of soil types. All penstemon species are mentioned for their value in mixes for erosion control and beautification values.

Management Implications. None listed.

Source: USDA 1988.

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SECTION 8

DETAILED PRESCRIPTIONS AND COST

Section 8: Detailed Prescriptions and Cost

The following section identifies specific prescriptions and costs associated with the implementation of the proposed alternatives. Total costs and acreages used for estimates are located in **Table 8.1**. Costs have been adjusted for Net Present Value.

Table 8.1 Summary of costs to implement alternatives.

Treatment	Total Acres Per Treatment	ARA ¹ cost/acre Net Present Value	IRA ² cost/acre Net Present Value	Total to Implement ARA - Net Present Value	Total to Implement IRA - Net Present Value
Tillage (T6/T12)	1,768	\$5,148 ³	\$17,410	\$9,102,317	\$30,781,177
Vegetation Improvement (VI)	246	\$4,500	\$8,624	\$1,108,294	\$2,124,069
Steep Slope Reclamation (SSR)	1,580	\$8,572	\$20,121	\$13,544,265	\$31,791,285
Well Vegetated (WV)	1,106	\$3,527	\$6,926	\$3,901,381	\$7,660,470
TOTALS	4,700			\$27,656,257	\$72,357,001

¹ ARA – Active Restoration Alternative

² IRA – Intensive Restoration Alternative

³ All costs listed in the above table are adjusted for Net Present Value

The proposed restoration plan will be implemented over 14 years. A timeline that presents the implementation schedule for restoration activities is presented in **Table 8.2**. The restoration timeline will be coordinated with remedy such that some treatments will commence following remedy, whereas other treatments are proposed to complement remedy work activities. In general, implementation of restoration for Tillage (T6 & T12), Vegetation Improvement, and Impacted Vegetation treatment areas will be conducted Years 1 through 8. Restoration for the Steep Slope Reclamation (SSR) treatment area will begin in Year 7 and conclude at Year 14. Spreadsheets that outline further detail concerning restoration prescriptions, costs, and timeline follow **Table 8.2**.

Table 8.2. Timeline for implementation and restoration activities at the Anaconda Uplands Injured Area. – See Table 5.1 for Summary of treatments for alternatives.

Restoration Treatments	Year																	
	1	2	3	4	5	6	7a	8a	7b	8b	9	10	11	12	13	14		
Site Preparation/ Amelioration Treatments	T6, T12, VI, and Impacted Vegetation														SSR			
Aerial Application of Agricultural Lime (Specification 6.1)									X									
Aerial Application of Fertilizers- Initial Rate (Specification 6.4)										X								
Aerial Application of Compost (Specification 6.5)											X							
Mechanical Compost Application/ Incorporation (Specification 6.6)	X																	
Mechanical Fertilizer Application- Initial Rate (Specification 6.8)		X																
Mechanical Compost Application- Surface (Specification 6.9)		X																
Seeding/ Planting Treatments																		
Aerial Seeding (Specification 6.2)										X								
Aerial Application of Hydromulch (Specification 6.3)										X								
Broadcast Seeding- Enhanced Mix (Specification 6.7)	X																	
Restoration Enhancement Planting (Specification 6.10)			X	X	X	X					X	X	X	X				
Install Plant Protectors (Specification 6.11)			X	X	X	X					X	X	X	X				
Maintenance																		
Aerial Application Of Fertilizers- Maintenance Rate (Specification 6.12)						X								X				
Maintenance of Plant Protectors (Specification 6.13)				X	X	X	X	X				X	X	X	X	X		
Replacement Plant Installation (Specification 6.14)				X	X	X	X					X	X	X	X			
Noxious Weed Control (Specification 6.15)			X	X	X	X	X				X	X	X	X	X			
Restoration Monitoring (Specification 6.16)			X	X	X	X	X	X			X	X	X	X	X	X		

8.1 Prescription: Tillage (T6)				
Restoration Alternative: Active Restoration				
Treatment Summary: Mechanical fertilizer application - initial rate; mechanical compost application - surface; restoration enhancement planting; install plant protectors; maintenance of plant protectors; replacement plant installation; noxious weed control; restoration monitoring				
Year	Treatment	Rate/acre	Unit	Cost/acre
2003	TOTAL COST PER ACRE, TILLAGE (T6), YEAR 1			\$0.00
2004	Mechanical fertilizer application - initial rate:			
	Mechanical fertilizer application	1	ton	\$40.00
	Implementation subtotal			\$40.00
	"Biosol Mix" (7-2-3) - organic fertilizer, initial rate	1	ton	\$540.00
	Materials subtotal			\$540.00
	Project Design and Work Plan - 3% of implementation costs	1	ls	\$1.20
	Project Management - 15% of implementation costs	1	ls	\$6.00
	Contractor's Margin - 10% of material costs	1	ls	\$60.00
	Contingency - 15% of total costs	1	ls	\$97.08
	Contractor Project Fees Subtotal			\$164.28
	TOTAL COST PER ACRE, MECHANICAL FERTILIZER APPLICATION - INITIAL RATE,			\$744.28
2004	Mechanical compost application - surface:			
	Mechanical compost application	34	cubic yard (cy)	\$374.00
	Implementation subtotal			\$374.00
	Compost	34	cy	\$476.00
	Materials subtotal			\$476.00
	Project Design and Work Plan - 3% of implementation costs	1	ls	\$11.22
	Project Management - 15% of implementation costs	1	ls	\$56.10
	Contractor's Margin - 10% of material costs	1	ls	\$52.89
	Contingency - 15% of total costs	1	ls	\$145.53
	Contractor Project Fees Subtotal			\$265.74
	TOTAL COST PER ACRE, MECHANICAL COMPOST APPLICATION - SURFACE, YEAR			\$1,115.74
	TOTAL COST PER ACRE, TILLAGE (T6), YEAR 2			\$1,860.02
2005	Restoration enhancement planting:			
	Airlift planting supplies to installation sites	1	ls	\$17.52
	Plant seedlings - includes placement of amendments in planting hole and installation of tree protectors	500	ls	\$372.66
	Implementation subtotal			\$390.18
	Containerized seedlings	500	seedlings	\$143.75
	"Bio-Pak" (16-6-8 + minors) slow release fertilizer, 1 packet/seedling	500	packet	\$7.50
	Pelletized compost - 1 pint/seedling	500	pint	\$6.48
	"Treepro Junior" - 4"x12" plant protector, 1	500	protector	\$57.50
	Materials subtotal			\$215.23
	Project Design and Work Plan - 3% of implementation costs	1	ls	\$11.71
	Monitoring - 1% of implementation costs	1	ls	\$3.90
	Project Management - 15% of implementation costs	1	ls	\$58.53
	Contractor's Margin - 10% of material costs	1	ls	\$23.91
	Contingency - 15% of total costs	1	ls	\$105.52
	Contractor Project Fees Subtotal			\$203.56
	TOTAL COST PER ACRE, RESTORATION ENHANCEMENT PLANTING, YEAR 3			\$808.97
2005	Noxious weed control:			

8.1 Prescription: Tillage (T6)			
	Release of beneficial insects for biological control of noxious weed species	1	ls \$10.30
	Implementation subtotal		\$10.30
	Beneficial insects	27	carton \$14.35
	Materials subtotal		\$14.35
	Project Design and Work Plan - 3% of implementation costs	1	ls \$0.31
	Monitoring - 1% of implementation costs	1	ls \$0.10
	Project Management - 15% of implementation costs	1	ls \$1.55
	Contractor's Margin - 10% of material costs	1	ls \$1.59
	Contingency - 15% of total costs	1	ls \$4.23
	Contractor Project Fees Subtotal		\$7.78
	TOTAL COST PER ACRE, NOXIOUS WEED CONTROL, YEAR 3		\$32.43
	TOTAL COST PER ACRE, TILLAGE (T6), YEAR 3		\$841.39
2006	Restoration enhancement planting:		
	Airlift planting supplies to installation sites	1	ls \$17.52
	Plant seedlings - includes placement of amendments in planting hole and installation of tree protectors	500	seedling \$372.66
	Implementation subtotal		\$390.18
	Containerized seedlings	500	seedlings \$143.75
	"Bio-Pak" (16-6-8 + minors) slow release fertilizer, 1	500	packet \$7.50
	Pelletized compost - 1 pint/seedling	500	pint \$6.48
	"Treepro Junior" - 4"x12" plant protector, 1	500	protector \$57.50
	Materials subtotal		\$215.23
	Project Design and Work Plan - 3% of implementation costs	1	ls \$11.71
	Monitoring - 1% of implementation costs	1	ls \$3.90
	Project Management - 15% of implementation costs	1	ls \$58.53
	Contractor's Margin - 10% of material costs	1	ls \$23.91
	Contingency - 15% of total costs	1	ls \$105.52
	Contractor Project Fees Subtotal		\$203.56
	TOTAL COST PER ACRE, RESTORATION ENHANCEMENT PLANTING, YEAR 4		\$808.97
2006	Replacement plant installation:		
	Airlift replanting supplies to installation sites - 20% of Year 3 airlift costs	1	ls \$3.50
	Plant replacement seedlings - 20% of Year 3 planting costs	1	ls \$74.53
	Implementation subtotal		\$78.04
	Replacement containerized seedlings - 20% of Year 3 totals	1	ls \$28.75
	Replacement plant protectors and amendments	1	ls \$14.30
	Materials subtotal		\$43.05
	Project Design and Work Plan - 3% of implementation costs	1	ls \$2.34
	Monitoring - 1% of implementation costs	1	ls \$0.78
	Project Management - 15% of implementation costs	1	ls \$11.71
	Contractor's Margin - 10% of material costs	1	ls \$4.78
	Contingency - 15% of total costs	1	ls \$21.10
	Contractor Project Fees Subtotal		\$40.71
	TOTAL COST PER ACRE, REPLACEMENT PLANT INSTALLATION, YEAR 4		\$161.79
2006	Maintenance of plant protectors:		
	Maintenance of plant protectors - 10% of Year 3 planting costs	1	ls \$37.27
	Implementation subtotal		\$37.27

8.1 Prescription: Tillage (T6)				
	Project Design and Work Plan - 3% of implementation costs	1	ls	\$1.12
	Monitoring - 1% of implementation costs	1	ls	\$0.37
	Project Management - 15% of implementation costs	1	ls	\$5.59
	Contingency - 15% of total costs	1	ls	\$6.65
	Contractor Project Fees Subtotal			\$13.73
	TOTAL COST PER ACRE, MAINTENANCE OF PLANT PROTECTORS, YEAR 4			\$51.00
2006	Noxious weed control:			
	Release of beneficial insects for biological control of noxious weed species	1	ls	\$10.30
	Implementation subtotal			\$10.30
	Beneficial insects	27	carton	\$14.35
	Materials subtotal			\$14.35
	Project Design and Work Plan - 3% of implementation costs	1	ls	\$0.31
	Monitoring - 1% of implementation costs	1	ls	\$0.10
	Project Management - 15% of implementation costs	1	ls	\$1.55
	Contractor's Margin - 10% of material costs	1	ls	\$1.59
	Contingency - 15% of total costs	1	ls	\$4.23
	Contractor Project Fees Subtotal			\$7.78
	TOTAL COST PER ACRE, NOXIOUS WEED CONTROL, YEAR 4			\$32.43
	TOTAL COST PER ACRE, TILLAGE (T6), YEAR 4			\$1,054.19
2007	Restoration enhancement planting:			
	Airlift planting supplies to installation sites	1	ls	\$17.52
	Plant seedlings - includes placement of amendments in planting hole and installation of tree protectors	500	seedling	\$372.66
	Implementation subtotal			\$390.18
	Containerized seedlings	500	seedlings	\$143.75
	"Bio-Pak" (16-6-8 + minors) slow release fertilizer, 1 packet/seedling	500	packet	\$7.50
	Pelletized compost - 1 pint/seedling	500	pint	\$6.48
	"Treepro Junior" - 4"x12" plant protector, 1	500	protector	\$57.50
	Materials subtotal			\$215.23
	Project Design and Work Plan - 3% of implementation costs	1	ls	\$11.71
	Monitoring - 1% of implementation costs	1	ls	\$3.90
	Project Management - 15% of implementation costs	1	ls	\$58.53
	Contractor's Margin - 10% of material costs	1	ls	\$23.91
	Contingency - 15% of total costs	1	ls	\$105.52
	Contractor Project Fees Subtotal			\$203.56
	TOTAL COST PER ACRE, RESTORATION ENHANCEMENT PLANTING, YEAR 5			\$808.97
2007	Replacement plant installation:			
	Airlift replanting supplies to installation sites - 20% of Year 4 airlift costs	1	ls	\$3.50
	Plant replacement seedlings - 20% of Year 4 planting costs	1	ls	\$74.53
	Implementation subtotal			\$78.04
	Replacement containerized seedlings - 20% of Year 3 totals	1	ls	\$28.75
	Replacement plant protectors and amendments	1	ls	\$14.30
	Materials subtotal			\$43.05
	Project Design and Work Plan - 3% of implementation costs	1	ls	\$2.34
	Monitoring - 1% of implementation costs	1	ls	\$0.78
	Project Management - 15% of implementation costs	1	ls	\$11.71
	Contractor's Margin - 10% of material costs	1	ls	\$4.78

8.1 Prescription: Tillage (T6)

	Contingency - 15% of total costs	1	ls	\$21.10
	Contractor Project Fees Subtotal			\$40.71
	TOTAL COST PER ACRE, REPLACEMENT PLANT INSTALLATION, YEAR 5			\$161.79
2007	Maintenance of plant protectors:			
	Maintenance of plant protectors - 10% of Years 3 and 4 planting costs	1	ls	\$74.53
	Implementation subtotal			\$74.53
	Project Design and Work Plan - 3% of implementation costs	1	ls	\$2.24
	Monitoring - 1% of implementation costs	1	ls	\$0.75
	Project Management - 15% of implementation costs	1	ls	\$11.18
	Contingency - 15% of total costs	1	ls	\$13.30
	Contractor Project Fees Subtotal			\$27.47
	TOTAL COST PER ACRE, MAINTENANCE OF PLANT PROTECTORS, YEAR 5			\$102.00
2007	Noxious weed control:			
	Release of beneficial insects for biological control of noxious weed species	1	ls	\$10.30
	Implementation subtotal			\$10.30
	Beneficial insects	27	carton	\$14.35
	Materials subtotal			\$14.35
	Project Design and Work Plan - 3% of implementation costs	1	ls	\$0.31
	Monitoring - 1% of implementation costs	1	ls	\$0.10
	Project Management - 15% of implementation costs	1	ls	\$1.55
	Contractor's Margin - 10% of material costs	1	ls	\$1.59
	Contingency - 15% of total costs	1	ls	\$4.23
	Contractor Project Fees Subtotal			\$7.78
	TOTAL COST PER ACRE, NOXIOUS WEED CONTROL, YEAR 5			\$32.43
	TOTAL COST PER ACRE, TILLAGE (T6), YEAR 5			\$1,105.19
2008	Restoration enhancement planting:			
	Airlift planting supplies to installation sites	1	ls	\$17.52
	Plant seedlings - includes placement of amendments in planting hole and installation of tree protectors	500	seedling	\$372.66
	Implementation subtotal			\$390.18
	Containerized seedlings	500	seedlings	\$143.75
	"Bio-Pak" (16-6-8 + minors) slow release fertilizer, 1 packet/seedling	500	packet	\$7.50
	Pelletized compost - 1 pint/seedling	500	pint	\$6.48
	"Treepro Junior" - 4"x12" plant protector, 1	500	protector	\$57.50
	Materials subtotal			\$215.23
	Project Design and Work Plan - 3% of implementation costs	1	ls	\$11.71
	Monitoring - 1% of implementation costs	1	ls	\$3.90
	Project Management - 15% of implementation costs	1	ls	\$58.53
	Contractor's Margin - 10% of material costs	1	ls	\$23.91
	Contingency - 15% of total costs	1	ls	\$105.52
	Contractor Project Fees Subtotal			\$203.56
	TOTAL COST PER ACRE, RESTORATION ENHANCEMENT PLANTING, YEAR 6			\$808.97
2008	Replacement plant installation:			
	Airlift replanting supplies to installation sites - 20% of Year 5 airlift costs	1	ls	\$3.50

8.1 Prescription: Tillage (T6)

	Plant replacement seedlings - 20% of Year 5 planting costs	1	ls	\$74.53
	Implementation subtotal			\$78.04
	Replacement containerized seedlings - 20% of Year 3 totals	1	ls	\$28.75
	Replacement plant protectors and amendments	1	ls	\$14.30
	Materials subtotal			\$43.05
	Project Design and Work Plan - 3% of implementation costs	1	ls	\$2.34
	Monitoring - 1% of implementation costs	1	ls	\$0.78
	Project Management - 15% of implementation costs	1	ls	\$11.71
	Contractor's Margin - 10% of material costs	1	ls	\$4.78
	Contingency - 15% of total costs	1	ls	\$21.10
	Contractor Project Fees Subtotal			\$40.71
	TOTAL COST PER ACRE, REPLACEMENT PLANT INSTALLATION, YEAR 6			\$161.79
2008	Maintenance of plant protectors:			
	Maintenance of plant protectors - 10% of Years 4 and 5 planting costs	1	ls	\$74.53
	Implementation subtotal			\$74.53
	Project Design and Work Plan - 3% of implementation costs	1	ls	\$2.24
	Monitoring - 1% of implementation costs	1	ls	\$0.75
	Project Management - 15% of implementation costs	1	ls	\$11.18
	Contingency - 15% of total costs	1	ls	\$13.30
	Contractor Project Fees Subtotal			\$27.47
	TOTAL COST PER ACRE, MAINTENANCE OF PLANT PROTECTORS, YEAR 6			\$102.00
2008	Noxious weed control:			
	Release of beneficial insects for biological control of noxious weed species	1	ls	\$10.30
	Implementation subtotal			\$10.30
	Beneficial insects	27	carton	\$14.35
	Materials subtotal			\$14.35
	Project Design and Work Plan - 3% of implementation costs	1	ls	\$0.31
	Monitoring - 1% of implementation costs	1	ls	\$0.10
	Project Management - 15% of implementation costs	1	ls	\$1.55
	Contractor's Margin - 10% of material costs	1	ls	\$1.59
	Contingency - 15% of total costs	1	ls	\$4.23
	Contractor Project Fees Subtotal			\$7.78
	TOTAL COST PER ACRE, NOXIOUS WEED CONTROL, YEAR 6			\$32.43
	TOTAL COST PER ACRE, TILLAGE (T6), YEAR 6			\$1,105.19
2009	Replacement plant installation:			
	Airlift replanting supplies to installation sites - 20% of Year 6 airlift costs	1	ls	\$3.50
	Plant replacement seedlings - 20% of Year 6 planting costs	1	ls	\$74.53
	Implementation subtotal			\$78.04
	Replacement containerized seedlings - 20% of Year 3 totals	1	ls	\$28.75
	Replacement plant protectors and amendments	1	ls	\$14.30
	Materials subtotal			\$43.05
	Project Design and Work Plan - 3% of implementation costs	1	ls	\$2.34
	Monitoring - 1% of implementation costs	1	ls	\$0.78
	Project Management - 15% of implementation costs	1	ls	\$11.71
	Contractor's Margin - 10% of material costs	1	ls	\$4.78
	Contingency - 15% of total costs	1	ls	\$21.10
	Contractor Project Fees Subtotal			\$40.71

8.1 Prescription: Tillage (T6)

TOTAL COST PER ACRE, REPLACEMENT PLANT INSTALLATION, YEAR 7				\$161.79
2009	Maintenance of plant protectors:			
	Maintenance of plant protectors - 10% of Years 5 and 6 planting costs	1	ls	\$74.53
	Implementation subtotal			\$74.53
	Project Design and Work Plan - 3% of implementation costs	1	ls	\$2.24
	Monitoring - 1% of implementation costs	1	ls	\$0.75
	Project Management - 15% of implementation costs	1	ls	\$11.18
	Contingency - 15% of total costs	1	ls	\$13.30
	Contractor Project Fees Subtotal			\$27.47
TOTAL COST PER ACRE, MAINTENANCE OF PLANT PROTECTORS, YEAR 7				\$102.00
2009	Noxious weed control:			
	Release of beneficial insects for biological control of noxious weed species	1	ls	\$10.30
	Implementation subtotal			\$10.30
	Beneficial insects	27	carton	\$14.35
	Materials subtotal			\$14.35
	Project Design and Work Plan - 3% of implementation costs	1	ls	\$0.31
	Monitoring - 1% of implementation costs	1	ls	\$0.10
	Project Management - 15% of implementation costs	1	ls	\$1.55
	Contractor's Margin - 10% of material costs	1	ls	\$1.59
	Contingency - 15% of total costs	1	ls	\$4.23
	Contractor Project Fees Subtotal			\$7.78
TOTAL COST PER ACRE, NOXIOUS WEED CONTROL, YEAR 7				\$32.43
TOTAL COST PER ACRE, TILLAGE (T6), YEAR 7				\$296.22
2010	Maintenance of plant protectors:			
	Maintenance of plant protectors - 10% of Years 6 and 7 planting costs	1	ls	\$37.27
	Implementation subtotal			\$37.27
	Project Design and Work Plan - 3% of implementation costs	1	ls	\$1.12
	Monitoring - 1% of implementation costs	1	ls	\$0.37
	Project Management - 15% of implementation costs	1	ls	\$5.59
	Contingency - 15% of total costs	1	ls	\$6.65
	Contractor Project Fees Subtotal			\$13.73
TOTAL COST PER ACRE, MAINTENANCE OF PLANT PROTECTORS, YEAR 8				\$51.00
TOTAL COST PER ACRE, TILLAGE (T6), YEAR 8				\$51.00
TOTAL COST PER ACRE, TILLAGE (T6), ACTIVE RESTORATION, ALL YEARS				\$6,313.19
TOTAL COST PER ACRE, TILLAGE (T6), ACTIVE RESTORATION, ALL YEARS - NET PRESENT VALUE				\$5,148.37

8.2 Prescription: Tillage (T12)				
Restoration Alternative: Active Restoration				
Treatment Summary: Mechanical fertilizer application - initial rate; mechanical compost application - surface; restoration enhancement planting; install plant protectors; maintenance of plant protectors; replacement plant installation; noxious weed control; restoration monitoring				
Year	Treatment	Rate/acre	Unit	Cost/acre
2003	TOTAL COST PER ACRE, TILLAGE (T12), YEAR 1			\$0.00
2004	Mechanical fertilizer application - initial rate:			
	Mechanical fertilizer application	1	ton	\$40.00
	Implementation subtotal			\$40.00
	"Biosol Mix" (7-2-3) - organic fertilizer, initial rate	1	ton	\$540.00
	Materials subtotal			\$540.00
	Project Design and Work Plan - 3% of implementation costs	1	ls	\$1.20
	Project Management - 15% of implementation costs	1	ls	\$6.00
	Contractor's Margin - 10% of material costs	1	ls	\$60.00
	Contingency - 15% of total costs	1	ls	\$97.08
	Contractor Project Fees Subtotal			\$164.28
	TOTAL COST PER ACRE, MECHANICAL FERTILIZER APPLICATION - INITIAL RATE,			\$744.28
2004	Mechanical compost application - surface:			
	Mechanical compost application	34	cubic yard (cy)	\$374.00
	Implementation subtotal			\$374.00
	Compost	34	cy	\$476.00
	Materials subtotal			\$476.00
	Project Design and Work Plan - 3% of implementation costs	1	ls	\$11.22
	Project Management - 15% of implementation costs	1	ls	\$56.10
	Contractor's Margin - 10% of material costs	1	ls	\$52.89
	Contingency - 15% of total costs	1	ls	\$145.53
	Contractor Project Fees Subtotal			\$265.74
	TOTAL COST PER ACRE, MECHANICAL COMPOST APPLICATION - SURFACE, YEAR			\$1,115.74
	TOTAL COST PER ACRE, TILLAGE (T12), YEAR 2			\$1,860.02
2005	Restoration enhancement planting:			
	Airlift planting supplies to installation sites	1	ls	\$17.52
	Plant seedlings - includes placement of amendments in planting hole and installation of tree protectors	500	ls	\$372.66
	Implementation subtotal			\$390.18
	Containerized seedlings	500	seedlings	\$143.75
	"Bio-Pak" (16-6-8 + minors) slow release fertilizer, 1 packet/seedling	500	packet	\$7.50
	Pelletized compost - 1 pint/seedling	500	pint	\$6.48
	"Treepro Junior" - 4"x12" plant protector, 1	500	protector	\$57.50
	Materials subtotal			\$215.23
	Project Design and Work Plan - 3% of implementation costs	1	ls	\$11.71
	Monitoring - 1% of implementation costs	1	ls	\$3.90
	Project Management - 15% of implementation costs	1	ls	\$58.53
	Contractor's Margin - 10% of material costs	1	ls	\$23.91
	Contingency - 15% of total costs	1	ls	\$105.52
	Contractor Project Fees Subtotal			\$203.56
	TOTAL COST PER ACRE, RESTORATION ENHANCEMENT PLANTING, YEAR 3			\$808.97
2005	Noxious weed control:			

8.2 Prescription: Tillage (T12)

	Release of beneficial insects for biological control of noxious weed species	1	ls	\$10.30
	Implementation subtotal			\$10.30
	Beneficial insects	27	carton	\$14.35
	Materials subtotal			\$14.35
	Project Design and Work Plan - 3% of implementation costs	1	ls	\$0.31
	Monitoring - 1% of implementation costs	1	ls	\$0.10
	Project Management - 15% of implementation costs	1	ls	\$1.55
	Contractor's Margin - 10% of material costs	1	ls	\$1.59
	Contingency - 15% of total costs	1	ls	\$4.23
	Contractor Project Fees Subtotal			\$7.78
	TOTAL COST PER ACRE, NOXIOUS WEED CONTROL, YEAR 3			\$32.43
	TOTAL COST PER ACRE, TILLAGE (T12), YEAR 3			\$841.39
2006	Restoration enhancement planting:			
	Airlift planting supplies to installation sites	1	ls	\$17.52
	Plant seedlings - includes placement of amendments in planting hole and installation of tree protectors	500	seedling	\$372.66
	Implementation subtotal			\$390.18
	Containerized seedlings	500	seedlings	\$143.75
	"Bio-Pak" (16-6-8 + minors) slow release fertilizer, 1	500	packet	\$7.50
	Pelletized compost - 1 pint/seedling	500	pint	\$6.48
	"Treepro Junior" - 4"x12" plant protector, 1	500	protector	\$57.50
	Materials subtotal			\$215.23
	Project Design and Work Plan - 3% of implementation costs	1	ls	\$11.71
	Monitoring - 1% of implementation costs	1	ls	\$3.90
	Project Management - 15% of implementation costs	1	ls	\$58.53
	Contractor's Margin - 10% of material costs	1	ls	\$23.91
	Contingency - 15% of total costs	1	ls	\$105.52
	Contractor Project Fees Subtotal			\$203.56
	TOTAL COST PER ACRE, RESTORATION ENHANCEMENT PLANTING, YEAR 4			\$808.97
2006	Replacement plant installation:			
	Airlift replanting supplies to installation sites - 20% of Year 3 airlift costs	1	ls	\$3.50
	Plant replacement seedlings - 20% of Year 3 planting costs	1	ls	\$74.53
	Implementation subtotal			\$78.04
	Replacement containerized seedlings - 20% of Year 3 totals	1	ls	\$28.75
	Replacement plant protectors and amendments	1	ls	\$14.30
	Materials subtotal			\$43.05
	Project Design and Work Plan - 3% of implementation costs	1	ls	\$2.34
	Monitoring - 1% of implementation costs	1	ls	\$0.78
	Project Management - 15% of implementation costs	1	ls	\$11.71
	Contractor's Margin - 10% of material costs	1	ls	\$4.78
	Contingency - 15% of total costs	1	ls	\$21.10
	Contractor Project Fees Subtotal			\$40.71
	TOTAL COST PER ACRE, REPLACEMENT PLANT INSTALLATION, YEAR 4			\$161.79
2006	Maintenance of plant protectors:			
	Maintenance of plant protectors - 10% of Year 3 planting costs	1	ls	\$37.27
	Implementation subtotal			\$37.27
	Project Design and Work Plan - 3% of implementation costs	1	ls	\$1.12

8.2 Prescription: Tillage (T12)

	Monitoring - 1% of implementation costs	1	ls	\$0.37
	Project Management - 15% of implementation costs	1	ls	\$5.59
	Contingency - 15% of total costs	1	ls	\$6.65
	Contractor Project Fees Subtotal			\$13.73
	TOTAL COST PER ACRE, MAINTENANCE OF PLANT PROTECTORS, YEAR 4			\$51.00
2006	Noxious weed control:			
	Release of beneficial insects for biological control of noxious weed species	1	ls	\$10.30
	Implementation subtotal			\$10.30
	Beneficial insects	27	carton	\$14.35
	Materials subtotal			\$14.35
	Project Design and Work Plan - 3% of implementation costs	1	ls	\$0.31
	Monitoring - 1% of implementation costs	1	ls	\$0.10
	Project Management - 15% of implementation costs	1	ls	\$1.55
	Contractor's Margin - 10% of material costs	1	ls	\$1.59
	Contingency - 15% of total costs	1	ls	\$4.23
	Contractor Project Fees Subtotal			\$7.78
	TOTAL COST PER ACRE, NOXIOUS WEED CONTROL, YEAR 4			\$32.43
	TOTAL COST PER ACRE, TILLAGE (T12), YEAR 4			\$1,054.19
2007	Restoration enhancement planting:			
	Airlift planting supplies to installation sites	1	ls	\$17.52
	Plant seedlings - includes placement of amendments in planting hole and installation of tree protectors	500	seedling	\$372.66
	Implementation subtotal			\$390.18
	Containerized seedlings	500	seedlings	\$143.75
	"Bio-Pak" (16-6-8 + minors) slow release fertilizer, 1 packet/seedling	500	packet	\$7.50
	Pelletized compost - 1 pint/seedling	500	pint	\$6.48
	"Treepro Junior" - 4"x12" plant protector, 1	500	protector	\$57.50
	Materials subtotal			\$215.23
	Project Design and Work Plan - 3% of implementation costs	1	ls	\$11.71
	Monitoring - 1% of implementation costs	1	ls	\$3.90
	Project Management - 15% of implementation costs	1	ls	\$58.53
	Contractor's Margin - 10% of material costs	1	ls	\$23.91
	Contingency - 15% of total costs	1	ls	\$105.52
	Contractor Project Fees Subtotal			\$203.56
	TOTAL COST PER ACRE, RESTORATION ENHANCEMENT PLANTING, YEAR 5			\$808.97
2007	Replacement plant installation:			
	Airlift replanting supplies to installation sites - 20% of Year 4 airlift costs	1	ls	\$3.50
	Plant replacement seedlings - 20% of Year 4 planting costs	1	ls	\$74.53
	Implementation subtotal			\$78.04
	Replacement containerized seedlings - 20% of Year 3 totals	1	ls	\$28.75
	Replacement plant protectors and amendments	1	ls	\$14.30
	Materials subtotal			\$43.05
	Project Design and Work Plan - 3% of implementation costs	1	ls	\$2.34
	Monitoring - 1% of implementation costs	1	ls	\$0.78
	Project Management - 15% of implementation costs	1	ls	\$11.71
	Contractor's Margin - 10% of material costs	1	ls	\$4.78
	Contingency - 15% of total costs	1	ls	\$21.10

8.2 Prescription: Tillage (T12)

Contractor Project Fees Subtotal				\$40.71
TOTAL COST PER ACRE, REPLACEMENT PLANT INSTALLATION, YEAR 5				\$161.79
2007	Maintenance of plant protectors:			
	Maintenance of plant protectors - 10% of Years 3 and 4 planting costs	1	ls	\$74.53
	Implementation subtotal			\$74.53
	Project Design and Work Plan - 3% of implementation costs	1	ls	\$2.24
	Monitoring - 1% of implementation costs	1	ls	\$0.75
	Project Management - 15% of implementation costs	1	ls	\$11.18
	Contingency - 15% of total costs	1	ls	\$13.30
	Contractor Project Fees Subtotal			\$27.47
TOTAL COST PER ACRE, MAINTENANCE OF PLANT PROTECTORS, YEAR 5				\$102.00
2007	Noxious weed control:			
	Release of beneficial insects for biological control of noxious weed species	1	ls	\$10.30
	Implementation subtotal			\$10.30
	Beneficial insects	27	carton	\$14.35
	Materials subtotal			\$14.35
	Project Design and Work Plan - 3% of implementation costs	1	ls	\$0.31
	Monitoring - 1% of implementation costs	1	ls	\$0.10
	Project Management - 15% of implementation costs	1	ls	\$1.55
	Contractor's Margin - 10% of material costs	1	ls	\$1.59
	Contingency - 15% of total costs	1	ls	\$4.23
	Contractor Project Fees Subtotal			\$7.78
TOTAL COST PER ACRE, NOXIOUS WEED CONTROL, YEAR 5				\$32.43
TOTAL COST PER ACRE, TILLAGE (T12), YEAR 5				\$1,105.19
2008	Restoration enhancement planting:			
	Airlift planting supplies to installation sites	1	ls	\$17.52
	Plant seedlings - includes placement of amendments in planting hole and installation of tree protectors	500	seedling	\$372.66
	Implementation subtotal			\$390.18
	Containerized seedlings	500	seedlings	\$143.75
	"Bio-Pak" (16-6-8 + minors) slow release fertilizer, 1 packet/seedling	500	packet	\$7.50
	Pelletized compost - 1 pint/seedling	500	pint	\$6.48
	"Treepro Junior" - 4"x12" plant protector, 1	500	protector	\$57.50
	Materials subtotal			\$215.23
	Project Design and Work Plan - 3% of implementation costs	1	ls	\$11.71
	Monitoring - 1% of implementation costs	1	ls	\$3.90
	Project Management - 15% of implementation costs	1	ls	\$58.53
	Contractor's Margin - 10% of material costs	1	ls	\$23.91
	Contingency - 15% of total costs	1	ls	\$105.52
	Contractor Project Fees Subtotal			\$203.56
TOTAL COST PER ACRE, RESTORATION ENHANCEMENT PLANTING, YEAR 6				\$808.97
2008	Replacement plant installation:			
	Airlift replanting supplies to installation sites - 20% of Year 5 airlift costs	1	ls	\$3.50
	Plant replacement seedlings - 20% of Year 5 planting costs	1	ls	\$74.53

8.2 Prescription: Tillage (T12)

				Implementation subtotal	\$78.04
	Replacement containerized seedlings - 20% of Year 3 totals	1	ls	\$28.75	
	Replacement plant protectors and amendments	1	ls	\$14.30	
				Materials subtotal	\$43.05
	Project Design and Work Plan - 3% of implementation costs	1	ls	\$2.34	
	Monitoring - 1% of implementation costs	1	ls	\$0.78	
	Project Management - 15% of implementation costs	1	ls	\$11.71	
	Contractor's Margin - 10% of material costs	1	ls	\$4.78	
	Contingency - 15% of total costs	1	ls	\$21.10	
				Contractor Project Fees Subtotal	\$40.71
TOTAL COST PER ACRE, REPLACEMENT PLANT INSTALLATION, YEAR 6					\$161.79
2008	Maintenance of plant protectors:				
	Maintenance of plant protectors - 10% of Years 4 and 5 planting costs	1	ls	\$74.53	
				Implementation subtotal	\$74.53
	Project Design and Work Plan - 3% of implementation costs	1	ls	\$2.24	
	Monitoring - 1% of implementation costs	1	ls	\$0.75	
	Project Management - 15% of implementation costs	1	ls	\$11.18	
	Contingency - 15% of total costs	1	ls	\$13.30	
				Contractor Project Fees Subtotal	\$27.47
TOTAL COST PER ACRE, MAINTENANCE OF PLANT PROTECTORS, YEAR 6					\$102.00
2008	Noxious weed control:				
	Release of beneficial insects for biological control of noxious weed species	1	ls	\$10.30	
				Implementation subtotal	\$10.30
	Beneficial insects	27	carton	\$14.35	
				Materials subtotal	\$14.35
	Project Design and Work Plan - 3% of implementation costs	1	ls	\$0.31	
	Monitoring - 1% of implementation costs	1	ls	\$0.10	
	Project Management - 15% of implementation costs	1	ls	\$1.55	
	Contractor's Margin - 10% of material costs	1	ls	\$1.59	
	Contingency - 15% of total costs	1	ls	\$4.23	
				Contractor Project Fees Subtotal	\$7.78
TOTAL COST PER ACRE, NOXIOUS WEED CONTROL, YEAR 6					\$32.43
TOTAL COST PER ACRE, TILLAGE (T12), YEAR 6					\$1,105.19
2009	Replacement plant installation:				
	Airlift replanting supplies to installation sites - 20% of Year 6 airlift costs	1	ls	\$3.50	
	Plant replacement seedlings - 20% of Year 6 planting costs	1	ls	\$74.53	
				Implementation subtotal	\$78.04
	Replacement containerized seedlings - 20% of Year 3 totals	1	ls	\$28.75	
	Replacement plant protectors and amendments	1	ls	\$14.30	
				Materials subtotal	\$43.05
	Project Design and Work Plan - 3% of implementation costs	1	ls	\$2.34	
	Monitoring - 1% of implementation costs	1	ls	\$0.78	
	Project Management - 15% of implementation costs	1	ls	\$11.71	
	Contractor's Margin - 10% of material costs	1	ls	\$4.78	
	Contingency - 15% of total costs	1	ls	\$21.10	
				Contractor Project Fees Subtotal	\$40.71

8.2 Prescription: Tillage (T12)

TOTAL COST PER ACRE, REPLACEMENT PLANT INSTALLATION, YEAR 7				\$161.79
2009	Maintenance of plant protectors:			
	Maintenance of plant protectors - 10% of Years 5 and 6 planting costs	1	ls	\$74.53
	Implementation subtotal			\$74.53
	Project Design and Work Plan - 3% of implementation costs	1	ls	\$2.24
	Monitoring - 1% of implementation costs	1	ls	\$0.75
	Project Management - 15% of implementation costs	1	ls	\$11.18
	Contingency - 15% of total costs	1	ls	\$13.30
	Contractor Project Fees Subtotal			\$27.47
TOTAL COST PER ACRE, MAINTENANCE OF PLANT PROTECTORS, YEAR 7				\$102.00
2009	Noxious weed control:			
	Release of beneficial insects for biological control of noxious weed species	1	ls	\$10.30
	Implementation subtotal			\$10.30
	Beneficial insects	27	carton	\$14.35
	Materials subtotal			\$14.35
	Project Design and Work Plan - 3% of implementation costs	1	ls	\$0.31
	Monitoring - 1% of implementation costs	1	ls	\$0.10
	Project Management - 15% of implementation costs	1	ls	\$1.55
	Contractor's Margin - 10% of material costs	1	ls	\$1.59
	Contingency - 15% of total costs	1	ls	\$4.23
	Contractor Project Fees Subtotal			\$7.78
TOTAL COST PER ACRE, NOXIOUS WEED CONTROL, YEAR 7				\$32.43
TOTAL COST PER ACRE, TILLAGE (T12), YEAR 7				\$296.22
2010	Maintenance of plant protectors:			
	Maintenance of plant protectors - 10% of Years 6 and 7 planting costs	1	ls	\$37.27
	Implementation subtotal			\$37.27
	Project Design and Work Plan - 3% of implementation costs	1	ls	\$1.12
	Monitoring - 1% of implementation costs	1	ls	\$0.37
	Project Management - 15% of implementation costs	1	ls	\$5.59
	Contingency - 15% of total costs	1	ls	\$6.65
	Contractor Project Fees Subtotal			\$13.73
TOTAL COST PER ACRE, MAINTENANCE OF PLANT PROTECTORS, YEAR 8				\$51.00
TOTAL COST PER ACRE, TILLAGE (T12), YEAR 8				\$51.00
TOTAL COST PER ACRE, TILLAGE (T12), ACTIVE RESTORATION, ALL YEARS				\$6,313.19
TOTAL COST PER ACRE, TILLAGE (T12), ACTIVE RESTORATION, ALL YEARS - NET PRESENT VALUE				\$5,148.37

8.3 Prescription: Vegetation Improvement (VI)				
Restoration Alternative: Active Restoration				
Treatment Summary: Mechanical compost application - surface; restoration enhancement planting; install plant protectors; maintenance of plant protectors; replacement plant installation; noxious weed control; restoration monitoring				
Year	Treatment	Rate/acre	Unit	Cost/acre
2003	TOTAL COST PER ACRE, VEGETATION IMPROVEMENT (VI), YEAR 1			\$0.00
2004	Mechanical compost application - surface:			
	Mechanical compost application	34	cubic yard (cy)	\$374.00
	Implementation subtotal			\$374.00
	Compost	34	cy	\$476.00
	Materials subtotal			\$476.00
	Project Design and Work Plan - 3% of implementation costs	1	ls	\$11.22
	Project Management - 15% of implementation costs	1	ls	\$56.10
	Contractor's Margin - 10% of material costs	1	ls	\$52.89
	Contingency - 15% of total costs	1	ls	\$145.53
	Contractor Project Fees Subtotal			\$265.74
	TOTAL COST PER ACRE, MECHANICAL COMPOST APPLICATION - SURFACE, YEAR			\$1,115.74
	TOTAL COST PER ACRE, VEGETATION IMPROVEMENT (VI), YEAR 2			\$1,115.74
2005	Restoration enhancement planting:			
	Airlift planting supplies to installation sites	1	ls	\$17.52
	Plant seedlings - includes placement of amendments in planting hole and installation of tree protectors	500	ls	\$372.66
	Implementation subtotal			\$390.18
	Containerized seedlings	500	seedlings	\$143.75
	"Bio-Pak" (16-6-8 + minors) slow release fertilizer, 1 packet/seedling	500	packet	\$7.50
	Pelletized compost - 1 pint/seedling	500	pint	\$6.48
	"Treepro Junior" - 4"x12" plant protector, 1	500	protector	\$57.50
	Materials subtotal			\$215.23
	Project Design and Work Plan - 3% of implementation costs	1	ls	\$11.71
	Monitoring - 1% of implementation costs	1	ls	\$3.90
	Project Management - 15% of implementation costs	1	ls	\$58.53
	Contractor's Margin - 10% of material costs	1	ls	\$23.91
	Contingency - 15% of total costs	1	ls	\$105.52
	Contractor Project Fees Subtotal			\$203.56
	TOTAL COST PER ACRE, RESTORATION ENHANCEMENT PLANTING, YEAR 3			\$808.97
2005	Noxious weed control:			
	Release of beneficial insects for biological control of noxious weed species	1	ls	\$10.30
	Implementation subtotal			\$10.30
	Beneficial insects	27	carton	\$14.35
	Materials subtotal			\$14.35
	Project Design and Work Plan - 3% of implementation costs	1	ls	\$0.31
	Monitoring - 1% of implementation costs	1	ls	\$0.10
	Project Management - 15% of implementation costs	1	ls	\$1.55
	Contractor's Margin - 10% of material costs	1	ls	\$1.59
	Contingency - 15% of total costs	1	ls	\$4.23
	Contractor Project Fees Subtotal			\$7.78
	TOTAL COST PER ACRE, NOXIOUS WEED CONTROL, YEAR 3			\$32.43

8.3 Prescription: Vegetation Improvement (VI)

TOTAL COST PER ACRE, VEGETATION IMPROVEMENT (VI), YEAR 3				\$841.39
2006	Restoration enhancement planting:			
	Airlift planting supplies to installation sites	1	ls	\$17.52
	Plant seedlings - includes placement of amendments in planting hole and installation of tree protectors	500	seedling	\$372.66
	Implementation subtotal			\$390.18
	Containerized seedlings	500	seedlings	\$143.75
	"Bio-Pak" (16-6-8 + minors) slow release fertilizer, 1	500	packet	\$7.50
	Pelletized compost - 1 pint/seedling	500	pint	\$6.48
	"Treepro Junior" - 4"x12" plant protector, 1	500	protector	\$57.50
	Materials subtotal			\$215.23
	Project Design and Work Plan - 3% of implementation costs	1	ls	\$11.71
	Monitoring - 1% of implementation costs	1	ls	\$3.90
	Project Management - 15% of implementation costs	1	ls	\$58.53
	Contractor's Margin - 10% of material costs	1	ls	\$23.91
	Contingency - 15% of total costs	1	ls	\$105.52
	Contractor Project Fees Subtotal			\$203.56
TOTAL COST PER ACRE, RESTORATION ENHANCEMENT PLANTING, YEAR 4				\$808.97
2006	Replacement plant installation:			
	Airlift replanting supplies to installation sites - 20% of Year 3 airlift costs	1	ls	\$3.50
	Plant replacement seedlings - 20% of Year 3 planting costs	1	ls	\$74.53
	Implementation subtotal			\$78.04
	Replacement containerized seedlings - 20% of Year 3 totals	1	ls	\$28.75
	Replacement plant protectors and amendments	1	ls	\$14.30
	Materials subtotal			\$43.05
	Project Design and Work Plan - 3% of implementation costs	1	ls	\$2.34
	Monitoring - 1% of implementation costs	1	ls	\$0.78
	Project Management - 15% of implementation costs	1	ls	\$11.71
	Contractor's Margin - 10% of material costs	1	ls	\$4.78
	Contingency - 15% of total costs	1	ls	\$21.10
	Contractor Project Fees Subtotal			\$40.71
TOTAL COST PER ACRE, REPLACEMENT PLANT INSTALLATION, YEAR 4				\$161.79
2006	Maintenance of plant protectors:			
	Maintenance of plant protectors - 10% of Year 3 planting costs	1	ls	\$37.27
	Implementation subtotal			\$37.27
	Project Design and Work Plan - 3% of implementation costs	1	ls	\$1.12
	Monitoring - 1% of implementation costs	1	ls	\$0.37
	Project Management - 15% of implementation costs	1	ls	\$5.59
	Contingency - 15% of total costs	1	ls	\$6.65
	Contractor Project Fees Subtotal			\$13.73
TOTAL COST PER ACRE, MAINTENANCE OF PLANT PROTECTORS, YEAR 4				\$51.00
2006	Noxious weed control:			
	Release of beneficial insects for biological control of noxious weed species	1	ls	\$10.30
	Implementation subtotal			\$10.30
	Beneficial insects	27	carton	\$14.35
	Materials subtotal			\$14.35

8.3 Prescription: Vegetation Improvement (VI)				
	Project Design and Work Plan - 3% of implementation costs	1	ls	\$0.31
	Monitoring - 1% of implementation costs	1	ls	\$0.10
	Project Management - 15% of implementation costs	1	ls	\$1.55
	Contractor's Margin - 10% of material costs	1	ls	\$1.59
	Contingency - 15% of total costs	1	ls	\$4.23
	Contractor Project Fees Subtotal			\$7.78
	TOTAL COST PER ACRE, NOXIOUS WEED CONTROL, YEAR 4			\$32.43
	TOTAL COST PER ACRE, VEGETATION IMPROVEMENT (VI), YEAR 4			\$1,054.19
2007	Restoration enhancement planting:			
	Airlift planting supplies to installation sites	1	ls	\$17.52
	Plant seedlings - includes placement of amendments in planting hole and installation of tree protectors	500	seedling	\$372.66
	Implementation subtotal			\$390.18
	Containerized seedlings	500	seedlings	\$143.75
	"Bio-Pak" (16-6-8 + minors) slow release fertilizer, 1 packet/seedling	500	packet	\$7.50
	Pelletized compost - 1 pint/seedling	500	pint	\$6.48
	"Treepro Junior" - 4"x12" plant protector, 1	500	protector	\$57.50
	Materials subtotal			\$215.23
	Project Design and Work Plan - 3% of implementation costs	1	ls	\$11.71
	Monitoring - 1% of implementation costs	1	ls	\$3.90
	Project Management - 15% of implementation costs	1	ls	\$58.53
	Contractor's Margin - 10% of material costs	1	ls	\$23.91
	Contingency - 15% of total costs	1	ls	\$105.52
	Contractor Project Fees Subtotal			\$203.56
	TOTAL COST PER ACRE, RESTORATION ENHANCEMENT PLANTING, YEAR 5			\$808.97
2007	Replacement plant installation:			
	Airlift replanting supplies to installation sites - 20% of Year 4 airlift costs	1	ls	\$3.50
	Plant replacement seedlings - 20% of Year 4 planting costs	1	ls	\$74.53
	Implementation subtotal			\$78.04
	Replacement containerized seedlings - 20% of Year 3 totals	1	ls	\$28.75
	Replacement plant protectors and amendments	1	ls	\$14.30
	Materials subtotal			\$43.05
	Project Design and Work Plan - 3% of implementation costs	1	ls	\$2.34
	Monitoring - 1% of implementation costs	1	ls	\$0.78
	Project Management - 15% of implementation costs	1	ls	\$11.71
	Contractor's Margin - 10% of material costs	1	ls	\$4.78
	Contingency - 15% of total costs	1	ls	\$21.10
	Contractor Project Fees Subtotal			\$40.71
	TOTAL COST PER ACRE, REPLACEMENT PLANT INSTALLATION, YEAR 5			\$161.79
2007	Maintenance of plant protectors:			
	Maintenance of plant protectors - 10% of Years 3 and 4 planting costs	1	ls	\$74.53
	Implementation subtotal			\$74.53
	Project Design and Work Plan - 3% of implementation costs	1	ls	\$2.24
	Monitoring - 1% of implementation costs	1	ls	\$0.75
	Project Management - 15% of implementation costs	1	ls	\$11.18
	Contingency - 15% of total costs	1	ls	\$13.30
	Contractor Project Fees Subtotal			\$27.47

8.3 Prescription: Vegetation Improvement (VI)

TOTAL COST PER ACRE, MAINTENANCE OF PLANT PROTECTORS, YEAR 5				\$102.00
2007	Noxious weed control:			
	Release of beneficial insects for biological control of noxious weed species	1	ls	\$10.30
	Implementation subtotal			\$10.30
	Beneficial insects	27	carton	\$14.35
	Materials subtotal			\$14.35
	Project Design and Work Plan - 3% of implementation costs	1	ls	\$0.31
	Monitoring - 1% of implementation costs	1	ls	\$0.10
	Project Management - 15% of implementation costs	1	ls	\$1.55
	Contractor's Margin - 10% of material costs	1	ls	\$1.59
	Contingency - 15% of total costs	1	ls	\$4.23
	Contractor Project Fees Subtotal			\$7.78
TOTAL COST PER ACRE, NOXIOUS WEED CONTROL, YEAR 5				\$32.43
TOTAL COST PER ACRE, VEGETATION IMPROVEMENT (VI), YEAR 5				\$1,105.19
2008	Restoration enhancement planting:			
	Airlift planting supplies to installation sites	1	ls	\$17.52
	Plant seedlings - includes placement of amendments in planting hole and installation of tree protectors	500	seedling	\$372.66
	Implementation subtotal			\$390.18
	Containerized seedlings	500	seedlings	\$143.75
	"Bio-Pak" (16-6-8 + minors) slow release fertilizer, 1 packet/seedling	500	packet	\$7.50
	Pelletized compost - 1 pint/seedling	500	pint	\$6.48
	"Treepro Junior" - 4"x12" plant protector, 1	500	protector	\$57.50
	Materials subtotal			\$215.23
	Project Design and Work Plan - 3% of implementation costs	1	ls	\$11.71
	Monitoring - 1% of implementation costs	1	ls	\$3.90
	Project Management - 15% of implementation costs	1	ls	\$58.53
	Contractor's Margin - 10% of material costs	1	ls	\$23.91
	Contingency - 15% of total costs	1	ls	\$105.52
	Contractor Project Fees Subtotal			\$203.56
TOTAL COST PER ACRE, RESTORATION ENHANCEMENT PLANTING, YEAR 6				\$808.97
2008	Replacement plant installation:			
	Airlift replanting supplies to installation sites - 20% of Year 5 airlift costs	1	ls	\$3.50
	Plant replacement seedlings - 20% of Year 5 planting costs	1	ls	\$74.53
	Implementation subtotal			\$78.04
	Replacement containerized seedlings - 20% of Year 3 totals	1	ls	\$28.75
	Replacement plant protectors and amendments	1	ls	\$14.30
	Materials subtotal			\$43.05
	Project Design and Work Plan - 3% of implementation costs	1	ls	\$2.34
	Monitoring - 1% of implementation costs	1	ls	\$0.78
	Project Management - 15% of implementation costs	1	ls	\$11.71
	Contractor's Margin - 10% of material costs	1	ls	\$4.78
	Contingency - 15% of total costs	1	ls	\$21.10
	Contractor Project Fees Subtotal			\$40.71
TOTAL COST PER ACRE, REPLACEMENT PLANT INSTALLATION, YEAR 6				\$161.79

8.3 Prescription: Vegetation Improvement (VI)

2008	Maintenance of plant protectors:			
	Maintenance of plant protectors - 10% of Years 4 and 5 planting costs	1	ls	\$74.53
	Implementation subtotal			\$74.53
	Project Design and Work Plan - 3% of implementation costs	1	ls	\$2.24
	Monitoring - 1% of implementation costs	1	ls	\$0.75
	Project Management - 15% of implementation costs	1	ls	\$11.18
	Contingency - 15% of total costs	1	ls	\$13.30
	Contractor Project Fees Subtotal			\$27.47
	TOTAL COST PER ACRE, MAINTENANCE OF PLANT PROTECTORS, YEAR 6			\$102.00
2008	Noxious weed control:			
	Release of beneficial insects for biological control of noxious weed species	1	ls	\$10.30
	Implementation subtotal			\$10.30
	Beneficial insects	27	carton	\$14.35
	Materials subtotal			\$14.35
	Project Design and Work Plan - 3% of implementation costs	1	ls	\$0.31
	Monitoring - 1% of implementation costs	1	ls	\$0.10
	Project Management - 15% of implementation costs	1	ls	\$1.55
	Contractor's Margin - 10% of material costs	1	ls	\$1.59
	Contingency - 15% of total costs	1	ls	\$4.23
	Contractor Project Fees Subtotal			\$7.78
	TOTAL COST PER ACRE, NOXIOUS WEED CONTROL, YEAR 6			\$32.43
	TOTAL COST PER ACRE, VEGETATION IMPROVEMENT (VI), YEAR 6			\$1,105.19
2009	Replacement plant installation:			
	Airlift replanting supplies to installation sites - 20% of Year 6 airlift costs	1	ls	\$3.50
	Plant replacement seedlings - 20% of Year 6 planting costs	1	ls	\$74.53
	Implementation subtotal			\$78.04
	Replacement containerized seedlings - 20% of Year 3 totals	1	ls	\$28.75
	Replacement plant protectors and amendments	1	ls	\$14.30
	Materials subtotal			\$43.05
	Project Design and Work Plan - 3% of implementation costs	1	ls	\$2.34
	Monitoring - 1% of implementation costs	1	ls	\$0.78
	Project Management - 15% of implementation costs	1	ls	\$11.71
	Contractor's Margin - 10% of material costs	1	ls	\$4.78
	Contingency - 15% of total costs	1	ls	\$21.10
	Contractor Project Fees Subtotal			\$40.71
	TOTAL COST PER ACRE, REPLACEMENT PLANT INSTALLATION, YEAR 7			\$161.79
2009	Maintenance of plant protectors:			
	Maintenance of plant protectors - 10% of Years 5 and 6 planting costs	1	ls	\$74.53
	Implementation subtotal			\$74.53
	Project Design and Work Plan - 3% of implementation costs	1	ls	\$2.24
	Monitoring - 1% of implementation costs	1	ls	\$0.75
	Project Management - 15% of implementation costs	1	ls	\$11.18
	Contingency - 15% of total costs	1	ls	\$13.30
	Contractor Project Fees Subtotal			\$27.47
	TOTAL COST PER ACRE, MAINTENANCE OF PLANT PROTECTORS, YEAR 7			\$102.00

8.3 Prescription: Vegetation Improvement (VI)

2009	Noxious weed control:			
	Release of beneficial insects for biological control of noxious weed species	1	ls	\$10.30
	Implementation subtotal			\$10.30
	Beneficial insects	27	carton	\$14.35
	Materials subtotal			\$14.35
	Project Design and Work Plan - 3% of implementation costs	1	ls	\$0.31
	Monitoring - 1% of implementation costs	1	ls	\$0.10
	Project Management - 15% of implementation costs	1	ls	\$1.55
	Contractor's Margin - 10% of material costs	1	ls	\$1.59
	Contingency - 15% of total costs	1	ls	\$4.23
	Contractor Project Fees Subtotal			\$7.78
	TOTAL COST PER ACRE, NOXIOUS WEED CONTROL, YEAR 7			\$32.43
	TOTAL COST PER ACRE, VEGETATION IMPROVEMENT (VI), YEAR 7			\$296.22
	2010	Maintenance of plant protectors:		
Maintenance of plant protectors - 10% of Years 6 and 7 planting costs		1	ls	\$37.27
Implementation subtotal			\$37.27	
Project Design and Work Plan - 3% of implementation costs		1	ls	\$1.12
Monitoring - 1% of implementation costs		1	ls	\$0.37
Project Management - 15% of implementation costs		1	ls	\$5.59
Contingency - 15% of total costs		1	ls	\$6.65
Contractor Project Fees Subtotal			\$13.73	
TOTAL COST PER ACRE, MAINTENANCE OF PLANT PROTECTORS, YEAR 8			\$51.00	
TOTAL COST PER ACRE, VEGETATION IMPROVEMENT (VI), YEAR 8			\$51.00	
TOTAL COST PER ACRE, VEGETATION IMPROVEMENT (VI), ACTIVE RESTORATION, ALL YEARS			\$5,568.91	
TOTAL COST PER ACRE, VEGETATION IMPROVEMENT (VI), ACTIVE RESTORATION, ALL YEARS - NET PRESENT VALUE			\$4,499.77	

8.4 Prescription: Steep Slope Reclamation (SSR)				
Restoration Alternative: Active Restoration				
Treatment Summary: Aerial application of agricultural lime; aerial application of fertilizers (initial rate); restoration enhancement planting; install plant protectors; maintenance of plant protectors; replacement plant installation; noxious weed control; restoration monitoring				
Year	Treatment	Rate/acre	Unit	Cost/acre
2009	Aerial application of agricultural lime:			
	Aerial lime application	7.5	ton	\$3,500.00
	Ground support - for aerial lime application	1	ls	\$616.16
	Mobilization - for aerial lime application	1	ls	\$45.60
	Implementation subtotal			\$4,161.76
	Dolomitic lime	7.5	ton	\$540.00
	"Soilmaster WR" - Polymer Tackifier	70	gallon	\$420.00
	Materials subtotal			\$960.00
	Project Design and Work Plan - 3% of implementation costs	1	ls	\$124.85
	Project Management - 15% of implementation costs	1	ls	\$624.26
	Contractor's Margin - 10% of material costs	1	ls	\$106.67
	Contingency - 15% of total costs	1	ls	\$896.63
	Contractor Project Fees Subtotal			\$1,752.41
	TOTAL COST PER ACRE, AERIAL APPLICATION OF AGRICULTURAL LIME, YEAR 1			\$6,874.17
	TOTAL COST PER ACRE, STEEP SLOPE RECLAMATION (SSR), YEAR 1			\$6,874.17
2010	Aerial application of fertilizers - initial rate			
	Aerial fertilization - dry application, initial rate	1	ls	\$176.48
	Implementation subtotal			\$176.48
	"Biosol Mix" (7-2-3) - organic fertilizer, initial rate	1	ton	\$540.00
	Materials subtotal			\$540.00
	Project Design and Work Plan - 3% of implementation costs	1	ls	\$5.29
	Project Management - 15% of implementation costs	1	ls	\$26.47
	Contractor's Margin - 10% of material costs	1	ls	\$60.00
	Contingency - 15% of total costs	1	ls	\$121.24
	Contractor Project Fees Subtotal			\$213.00
	TOTAL COST PER ACRE, AERIAL APPLICATION OF FERTILIZER - INITIAL RATE,			\$929.48
	TOTAL COST PER ACRE, STEEP SLOPE RECLAMATION (SSR), YEAR 2			\$929.48
2011	Restoration enhancement planting:			
	Airlift planting supplies to installation sites	1	ls	\$17.52
	Plant seedlings - includes placement of amendments in planting hole and installation of tree protectors	500	plant	\$372.66
	Implementation subtotal			\$390.18
	Containerized seedlings	500	seedlings	\$143.75
	"Bio-Pak" (16-6-8 + minors) slow release fertilizer, 1 packet/seedling	500	packet	\$7.50
	Pelletized compost - 1 pint/seedling	500	pint	\$6.48
	"Treepro Junior" - 4"x12" plant protector, 1	500	protector	\$57.50
	Materials subtotal			\$215.23
	Project Design and Work Plan - 3% of implementation costs	1	ls	\$11.71
	Monitoring - 1% of implementation costs	1	ls	\$3.90
	Project Management - 15% of implementation costs	1	ls	\$58.53
	Contractor's Margin - 10% of material costs	1	ls	\$23.91
	Contingency - 15% of total costs	1	ls	\$105.52
	Contractor Project Fees Subtotal			\$203.56

8.4 Prescription: Steep Slope Reclamation (SSR)

TOTAL COST PER ACRE, RESTORATION ENHANCEMENT PLANTING, YEAR 3				\$808.97
2011	Noxious weed control:			
	Release of beneficial insects for biological control of noxious weed species	1	ls	\$10.30
	Implementation subtotal			\$10.30
	Beneficial insects	27	carton	\$14.35
	Materials subtotal			\$14.35
	Project Design and Work Plan - 3% of implementation costs	1	ls	\$0.31
	Monitoring - 1% of implementation costs	1	ls	\$0.10
	Project Management - 15% of implementation costs	1	ls	\$1.55
	Contractor's Margin - 10% of material costs	1	ls	\$1.59
	Contingency - 15% of total costs	1	ls	\$4.23
	Contractor Project Fees Subtotal			\$7.78
TOTAL COST PER ACRE, NOXIOUS WEED CONTROL, YEAR 3				\$32.43
TOTAL COST PER ACRE, STEEP SLOPE RECLAMATION (SSR), YEAR 3				\$841.39
2012	Restoration enhancement planting:			
	Airlift planting supplies to installation sites	1	ls	\$17.52
	Plant seedlings - includes placement of amendments in planting hole and installation of tree protectors	500	seedling	\$372.66
	Implementation subtotal			\$390.18
	Containerized seedlings	500	seedlings	\$143.75
	"Bio-Pak" (16-6-8 + minors) slow release fertilizer, 1 packet/seedling	500	packet	\$7.50
	Pelletized compost - 1 pint/seedling	500	pint	\$6.48
	"Treepro Junior" - 4"x12" plant protector, 1	500	protector	\$57.50
	Materials subtotal			\$215.23
	Project Design and Work Plan - 3% of implementation costs	1	ls	\$11.71
	Monitoring - 1% of implementation costs	1	ls	\$3.90
	Project Management - 15% of implementation costs	1	ls	\$58.53
	Contractor's Margin - 10% of material costs	1	ls	\$23.91
	Contingency - 15% of total costs	1	ls	\$105.52
	Contractor Project Fees Subtotal			\$203.56
TOTAL COST PER ACRE, RESTORATION ENHANCEMENT PLANTING, YEAR 4				\$808.97
2012	Replacement plant installation:			
	Airlift replanting supplies to installation sites - 20% of Year 3 airlift costs	1	ls	\$3.50
	Plant replacement seedlings - 20% of Year 3 planting costs	1	ls	\$74.53
	Implementation subtotal			\$78.04
	Replacement containerized seedlings - 20% of Year 3 totals	1	ls	\$28.75
	Replacement plant protectors and amendments	1	ls	\$14.30
	Materials subtotal			\$43.05
	Project Design and Work Plan - 3% of implementation costs	1	ls	\$2.34
	Monitoring - 1% of implementation costs	1	ls	\$0.78
	Project Management - 15% of implementation costs	1	ls	\$11.71
	Contractor's Margin - 10% of material costs	1	ls	\$4.78
	Contingency - 15% of total costs	1	ls	\$21.10
	Contractor Project Fees Subtotal			\$40.71
TOTAL COST PER ACRE, REPLACEMENT PLANT INSTALLATION, YEAR 4				\$161.79

8.4 Prescription: Steep Slope Reclamation (SSR)

2012	Maintenance of plant protectors:			
	Maintenance of plant protectors - 10% of Year 3 planting costs	1	ls	\$37.27
	Implementation subtotal			\$37.27
	Project Design and Work Plan - 3% of implementation costs	1	ls	\$1.12
	Monitoring - 1% of implementation costs	1	ls	\$0.37
	Project Management - 15% of implementation costs	1	ls	\$5.59
	Contingency - 15% of total costs	1	ls	\$6.65
	Contractor Project Fees Subtotal			\$13.73
	TOTAL COST PER ACRE, MAINTENANCE OF PLANT PROTECTORS, YEAR 4			\$51.00
2012	Noxious weed control:			
	Release of beneficial insects for biological control of noxious weed species	1	ls	\$10.30
	Implementation subtotal			\$10.30
	Beneficial insects	27	carton	\$14.35
	Materials subtotal			\$14.35
	Project Design and Work Plan - 3% of implementation costs	1	ls	\$0.31
	Monitoring - 1% of implementation costs	1	ls	\$0.10
	Project Management - 15% of implementation costs	1	ls	\$1.55
	Contractor's Margin - 10% of material costs	1	ls	\$1.59
	Contingency - 15% of total costs	1	ls	\$4.23
	Contractor Project Fees Subtotal			\$7.78
	TOTAL COST PER ACRE, NOXIOUS WEED CONTROL, YEAR 4			\$32.43
	TOTAL COST PER ACRE, STEEP SLOPE RECLAMATION (SSR), YEAR 4			\$1,054.19
2013	Restoration enhancement planting:			
	Airlift planting supplies to installation sites	1	ls	\$17.52
	Plant seedlings - includes placement of amendments in planting hole and installation of tree protectors	500	ls	\$372.66
	Implementation subtotal			\$390.18
	Containerized seedlings	500	seedlings	\$143.75
	"Bio-Pak" (16-6-8 + minors) slow release fertilizer, 1 packet/seedling	500	packet	\$7.50
	Pelletized compost - 1 pint/seedling	500	pint	\$6.48
	"Treepro Junior" - 4"x12" plant protector, 1	500	protector	\$57.50
	Materials subtotal			\$215.23
	Project Design and Work Plan - 3% of implementation costs	1	ls	\$11.71
	Monitoring - 1% of implementation costs	1	ls	\$3.90
	Project Management - 15% of implementation costs	1	ls	\$58.53
	Contractor's Margin - 10% of material costs	1	ls	\$23.91
	Contingency - 15% of total costs	1	ls	\$105.52
	Contractor Project Fees Subtotal			\$203.56
	TOTAL COST PER ACRE, RESTORATION ENHANCEMENT PLANTING, YEAR 5			\$808.97
2013	Replacement plant installation:			
	Airlift replanting supplies to installation sites - 20% of Year 4 airlift costs	1	ls	\$3.50
	Plant replacement seedlings - 20% of Year 4 planting costs	1	ls	\$74.53
	Implementation subtotal			\$78.04
	Replacement containerized seedlings - 20% of Year 3 totals	1	ls	\$28.75
	Replacement plant protectors and amendments	1	ls	\$14.30
	Materials subtotal			\$43.05

8.4 Prescription: Steep Slope Reclamation (SSR)

	Project Design and Work Plan - 3% of implementation costs	1	ls	\$2.34
	Monitoring - 1% of implementation costs	1	ls	\$0.78
	Project Management - 15% of implementation costs	1	ls	\$11.71
	Contractor's Margin - 10% of material costs	1	ls	\$4.78
	Contingency - 15% of total costs	1	ls	\$21.10
	Contractor Project Fees Subtotal			\$40.71
	TOTAL COST PER ACRE, REPLACEMENT PLANT INSTALLATION, YEAR 5			\$161.79
2013	Maintenance of plant protectors:			
	Maintenance of plant protectors - 10% of Years 3 and 4 planting costs	1	ls	\$74.53
	Implementation subtotal			\$74.53
	Project Design and Work Plan - 3% of implementation costs	1	ls	\$2.24
	Monitoring - 1% of implementation costs	1	ls	\$0.75
	Project Management - 15% of implementation costs	1	ls	\$11.18
	Contingency - 15% of total costs	1	ls	\$13.30
	Contractor Project Fees Subtotal			\$27.47
	TOTAL COST PER ACRE, MAINTENANCE OF PLANT PROTECTORS, YEAR 5			\$102.00
2013	Noxious weed control:			
	Release of beneficial insects for biological control of noxious weed species	1	ls	\$10.30
	Implementation subtotal			\$10.30
	Beneficial insects	27	carton	\$14.35
	Materials subtotal			\$14.35
	Project Design and Work Plan - 3% of implementation costs	1	ls	\$0.31
	Monitoring - 1% of implementation costs	1	ls	\$0.10
	Project Management - 15% of implementation costs	1	ls	\$1.55
	Contractor's Margin - 10% of material costs	1	ls	\$1.59
	Contingency - 15% of total costs	1	ls	\$4.23
	Contractor Project Fees Subtotal			\$7.78
	TOTAL COST PER ACRE, NOXIOUS WEED CONTROL, YEAR 5			\$32.43
	TOTAL COST PER ACRE, STEEP SLOPE RECLAMATION (SSR), YEAR 5			\$1,105.19
2014	Restoration enhancement planting:			
	Airlift planting supplies to installation sites	1	ls	\$17.52
	Plant seedlings - includes placement of amendments in planting hole and installation of tree protectors	500	ls	\$372.66
	Implementation subtotal			\$390.18
	Containerized seedlings	500	seedlings	\$143.75
	"Bio-Pak" (16-6-8 + minors) slow release fertilizer, 1 packet/seedling	500	packet	\$7.50
	Pelletized compost - 1 pint/seedling	500	pint	\$6.48
	"Treepro Junior" - 4"x12" plant protector, 1	500	protector	\$57.50
	Materials subtotal			\$215.23
	Project Design and Work Plan - 3% of implementation costs	1	ls	\$11.71
	Monitoring - 1% of implementation costs	1	ls	\$3.90
	Project Management - 15% of implementation costs	1	ls	\$58.53
	Contractor's Margin - 10% of material costs	1	ls	\$23.91
	Contingency - 15% of total costs	1	ls	\$105.52
	Contractor Project Fees Subtotal			\$203.56
	TOTAL COST PER ACRE, RESTORATION ENHANCEMENT PLANTING, YEAR 6			\$808.97

8.4 Prescription: Steep Slope Reclamation (SSR)

2014 Replacement plant installation:				
Airlift replanting supplies to installation sites - 20% of Year 5 airlift costs	1	ls		\$3.50
Plant replacement seedlings - 20% of Year 5 planting costs	1	ls		\$74.53
Implementation subtotal				\$78.04
Replacement containerized seedlings - 20% of Year 3 totals	1	ls		\$28.75
Replacement plant protectors and amendments	1	ls		\$14.30
Materials subtotal				\$43.05
Project Design and Work Plan - 3% of implementation costs	1	ls		\$2.34
Monitoring - 1% of implementation costs	1	ls		\$0.78
Project Management - 15% of implementation costs	1	ls		\$11.71
Contractor's Margin - 10% of material costs	1	ls		\$4.78
Contingency - 15% of total costs	1	ls		\$21.10
Contractor Project Fees Subtotal				\$40.71
TOTAL COST PER ACRE, REPLACEMENT PLANT INSTALLATION, YEAR 6				\$161.79
2014 Maintenance of plant protectors:				
Maintenance of plant protectors - 10% of Years 4 and 5 planting costs	1	ls		\$74.53
Implementation subtotal				\$74.53
Project Design and Work Plan - 3% of implementation costs	1	ls		\$2.24
Monitoring - 1% of implementation costs	1	ls		\$0.75
Project Management - 15% of implementation costs	1	ls		\$11.18
Contingency - 15% of total costs	1	ls		\$13.30
Contractor Project Fees Subtotal				\$27.47
TOTAL COST PER ACRE, MAINTENANCE OF PLANT PROTECTORS, YEAR 6				\$102.00
2014 Noxious weed control:				
Release of beneficial insects for biological control of noxious weed species	1	ls		\$10.30
Implementation subtotal				\$10.30
Beneficial insects	27	carton		\$14.35
Materials subtotal				\$14.35
Project Design and Work Plan - 3% of implementation costs	1	ls		\$0.31
Monitoring - 1% of implementation costs	1	ls		\$0.10
Project Management - 15% of implementation costs	1	ls		\$1.55
Contractor's Margin - 10% of material costs	1	ls		\$1.59
Contingency - 15% of total costs	1	ls		\$4.23
Contractor Project Fees Subtotal				\$7.78
TOTAL COST PER ACRE, NOXIOUS WEED CONTROL, YEAR 6				\$32.43
TOTAL COST PER ACRE, STEEP SLOPE RECLAMATION (SSR), YEAR 6				\$1,105.19
2015 Replacement plant installation:				
Airlift replanting supplies to installation sites - 20% of Year 6 airlift costs	1	ls		\$3.50
Plant replacement seedlings - 20% of Year 6 planting costs	1	ls		\$74.53
Implementation subtotal				\$78.04
Replacement containerized seedlings - 20% of Year 3 totals	1	ls		\$28.75
Replacement plant protectors and amendments	1	ls		\$14.30
Materials subtotal				\$43.05
Project Design and Work Plan - 3% of implementation costs	1	ls		\$2.34
Monitoring - 1% of implementation costs	1	ls		\$0.78

8.4 Prescription: Steep Slope Reclamation (SSR)				
	Project Management - 15% of implementation costs	1	ls	\$11.71
	Contractor's Margin - 10% of material costs	1	ls	\$4.78
	Contingency - 15% of total costs	1	ls	\$21.10
	Contractor Project Fees Subtotal			\$40.71
	TOTAL COST PER ACRE, REPLACEMENT PLANT INSTALLATION, YEAR 7			\$161.79
2015	Maintenance of plant protectors:			
	Maintenance of plant protectors - 10% of Years 5 and 6 planting costs	1	ls	\$74.53
	Implementation subtotal			\$74.53
	Project Design and Work Plan - 3% of implementation costs	1	ls	\$2.24
	Monitoring - 1% of implementation costs	1	ls	\$0.75
	Project Management - 15% of implementation costs	1	ls	\$11.18
	Contingency - 15% of total costs	1	ls	\$13.30
	Contractor Project Fees Subtotal			\$27.47
	TOTAL COST PER ACRE, MAINTENANCE OF PLANT PROTECTORS, YEAR 7			\$102.00
2015	Noxious weed control:			
	Release of beneficial insects for biological control of noxious weed species	1	ls	\$10.30
	Implementation subtotal			\$10.30
	Beneficial insects	27	carton	\$14.35
	Materials subtotal			\$14.35
	Project Design and Work Plan - 3% of implementation costs	1	ls	\$0.31
	Monitoring - 1% of implementation costs	1	ls	\$0.10
	Project Management - 15% of implementation costs	1	ls	\$1.55
	Contractor's Margin - 10% of material costs	1	ls	\$1.59
	Contingency - 15% of total costs	1	ls	\$4.23
	Contractor Project Fees Subtotal			\$7.78
	TOTAL COST PER ACRE, NOXIOUS WEED CONTROL, YEAR 7			\$32.43
	TOTAL COST PER ACRE, STEEP SLOPE RECLAMATION (SSR), YEAR 7			\$296.22
2016	Maintenance of plant protectors:			
	Maintenance of plant protectors - 10% of Years 6 and 7 planting costs	1	ls	\$37.27
	Implementation subtotal			\$37.27
	Project Design and Work Plan - 3% of implementation costs	1	ls	\$1.12
	Monitoring - 1% of implementation costs	1	ls	\$0.37
	Project Management - 15% of implementation costs	1	ls	\$5.59
	Contingency - 15% of total costs	1	ls	\$6.65
	Contractor Project Fees Subtotal			\$13.73
	TOTAL COST PER ACRE, MAINTENANCE OF PLANT PROTECTORS, YEAR 8			\$51.00
	TOTAL COST PER ACRE, STEEP SLOPE RECLAMATION (SSR), YEAR 8			\$51.00
	TOTAL COST PER ACRE, STEEP SLOPE RECLAMATION (SSR), ACTIVE RESTORATION, ALL YEARS			\$12,256.83
	TOTAL COST PER ACRE, STEEP SLOPE RECLAMATION (SSR), ACTIVE RESTORATION, ALL YEARS - NET PRESENT VALUE			\$8,572.32

8.5 Prescription: Well Vegetated (WV)				
Restoration Alternative: Active Restoration				
Treatment Summary: Restoration enhancement planting; install plant protectors; maintenance of plant protectors; replacement plant installation; noxious weed control; restoration monitoring				
Year	Treatment	Rate/acre	Unit	Cost/acre
2003	TOTAL COST PER ACRE, WELL VEGETATED (WV), YEAR 1			\$0.00
2004	TOTAL COST PER ACRE, WELL VEGETATED (WV), YEAR 2			\$0.00
2005	Restoration enhancement planting:			
	Airlift planting supplies to installation sites	1	ls	\$17.52
	Plant seedlings - includes placement of amendments in planting hole and installation of tree protectors	500	ls	\$372.66
	Implementation subtotal			\$390.18
	Containerized seedlings	500	seedlings	\$143.75
	"Bio-Pak" (16-6-8 + minors) slow release fertilizer, 1 packet/seedling	500	packet	\$7.50
	Pelletized compost - 1 pint/seedling	500	pint	\$6.48
	"Treepro Junior" - 4"x12" plant protector, 1	500	protector	\$57.50
	Materials subtotal			\$215.23
	Project Design and Work Plan - 3% of Implementation costs	1	ls	\$11.71
	Monitoring - 1% of Implementation costs	1	ls	\$3.90
	Project Management - 15% of Implementation costs	1	ls	\$58.53
	Contractor's Margin - 10% of material costs	1	ls	\$23.91
	Contingency - 15% of total costs	1	ls	\$105.52
	Contractor Project Fees Subtotal			\$203.56
	TOTAL COST PER ACRE, RESTORATION ENHANCEMENT PLANTING, YEAR 3			\$808.97
2005	Noxious weed control:			
	Release of beneficial insects for biological control of noxious weed species	1	ls	\$10.30
	Implementation subtotal			\$10.30
	Beneficial insects	27	carton	\$14.35
	Materials subtotal			\$14.35
	Project Design and Work Plan - 3% of Implementation costs	1	ls	\$0.31
	Monitoring - 1% of Implementation costs	1	ls	\$0.10
	Project Management - 15% of Implementation costs	1	ls	\$1.55
	Contractor's Margin - 10% of material costs	1	ls	\$1.59
	Contingency - 15% of total costs	1	ls	\$4.23
	Contractor Project Fees Subtotal			\$7.78
	TOTAL COST PER ACRE, NOXIOUS WEED CONTROL, YEAR 3			\$32.43
	TOTAL COST PER ACRE, WELL VEGETATED (WV), YEAR 3			\$841.39
2006	Restoration enhancement planting:			
	Airlift planting supplies to installation sites	1	ls	\$17.52
	Plant seedlings - includes placement of amendments in planting hole and installation of tree protectors	500	seedling	\$372.66
	Implementation subtotal			\$390.18
	Containerized seedlings	500	seedlings	\$143.75
	"Bio-Pak" (16-6-8 + minors) slow release fertilizer, 1	500	packet	\$7.50
	Pelletized compost - 1 pint/seedling	500	pint	\$6.48
	"Treepro Junior" - 4"x12" plant protector, 1	500	protector	\$57.50
	Materials subtotal			\$215.23

8.5 Prescription: Well Vegetated (WV)				
	Project Design and Work Plan - 3% of Implementation costs	1	ls	\$11.71
	Monitoring - 1% of Implementation costs	1	ls	\$3.90
	Project Management - 15% of Implementation costs	1	ls	\$58.53
	Contractor's Margin - 10% of material costs	1	ls	\$23.91
	Contingency - 15% of total costs	1	ls	\$105.52
	Contractor Project Fees Subtotal			\$203.56
	TOTAL COST PER ACRE, RESTORATION ENHANCEMENT PLANTING, YEAR 4			\$808.97
2006	Replacement plant installation:			
	Airlift replanting supplies to installation sites - 20% of Year 3 airlift costs	1	ls	\$3.50
	Plant replacement seedlings - 20% of Year 3 planting costs	1	ls	\$74.53
	Implementation subtotal			\$78.04
	Replacement containerized seedlings - 20% of Year 3 totals	1	ls	\$28.75
	Replacement plant protectors and amendments	1	ls	\$14.30
	Materials subtotal			\$43.05
	Project Design and Work Plan - 3% of Implementation costs	1	ls	\$2.34
	Monitoring - 1% of Implementation costs	1	ls	\$0.78
	Project Management - 15% of Implementation costs	1	ls	\$11.71
	Contractor's Margin - 10% of material costs	1	ls	\$4.78
	Contingency - 15% of total costs	1	ls	\$21.10
	Contractor Project Fees Subtotal			\$40.71
	TOTAL COST PER ACRE, REPLACEMENT PLANT INSTALLATION, YEAR 4			\$161.79
2006	Maintenance of plant protectors:			
	Maintenance of plant protectors - 10% of Year 3 planting costs	1	ls	\$37.27
	Implementation subtotal			\$37.27
	Project Design and Work Plan - 3% of Implementation costs	1	ls	\$1.12
	Monitoring - 1% of Implementation costs	1	ls	\$0.37
	Project Management - 15% of Implementation costs	1	ls	\$5.59
	Contingency - 15% of total costs	1	ls	\$6.65
	Contractor Project Fees Subtotal			\$13.73
	TOTAL COST PER ACRE, MAINTENANCE OF PLANT PROTECTORS, YEAR 4			\$51.00
2006	Noxious weed control:			
	Release of beneficial insects for biological control of noxious weed species	1	ls	\$10.30
	Implementation subtotal			\$10.30
	Beneficial insects	27	carton	\$14.35
	Materials subtotal			\$14.35
	Project Design and Work Plan - 3% of Implementation costs	1	ls	\$0.31
	Monitoring - 1% of Implementation costs	1	ls	\$0.10
	Project Management - 15% of Implementation costs	1	ls	\$1.55
	Contractor's Margin - 10% of material costs	1	ls	\$1.59
	Contingency - 15% of total costs	1	ls	\$4.23
	Contractor Project Fees Subtotal			\$7.78
	TOTAL COST PER ACRE, NOXIOUS WEED CONTROL, YEAR 4			\$32.43
	TOTAL COST PER ACRE, WELL VEGETATED (WV), YEAR 4			\$1,054.19
2007	Restoration enhancement planting:			
	Airlift planting supplies to installation sites	1	ls	\$17.52

8.5 Prescription: Well Vegetated (WV)

	Plant seedlings - includes placement of amendments in planting hole and installation of tree protectors	500	seedling	\$372.66
	Implementation subtotal			\$390.18
	Containerized seedlings	500	seedlings	\$143.75
	"Bio-Pak" (16-6-8 + minors) slow release fertilizer, 1 packet/seedling	500	packet	\$7.50
	Pelletized compost - 1 pint/seedling	500	pint	\$6.48
	"Treepro Junior" - 4"x12" plant protector, 1	500	protector	\$57.50
	Materials subtotal			\$215.23
	Project Design and Work Plan - 3% of Implementation costs	1	ls	\$11.71
	Monitoring - 1% of Implementation costs	1	ls	\$3.90
	Project Management - 15% of Implementation costs	1	ls	\$58.53
	Contractor's Margin - 10% of material costs	1	ls	\$23.91
	Contingency - 15% of total costs	1	ls	\$105.52
	Contractor Project Fees Subtotal			\$203.56
	TOTAL COST PER ACRE, RESTORATION ENHANCEMENT PLANTING, YEAR 5			\$808.97
2007	Replacement plant installation:			
	Airlift replanting supplies to installation sites - 20% of Year 4 airlift costs	1	ls	\$3.50
	Plant replacement seedlings - 20% of Year 4 planting costs	1	ls	\$74.53
	Implementation subtotal			\$78.04
	Replacement containerized seedlings - 20% of Year 3 totals	1	ls	\$28.75
	Replacement plant protectors and amendments	1	ls	\$14.30
	Materials subtotal			\$43.05
	Project Design and Work Plan - 3% of Implementation costs	1	ls	\$2.34
	Monitoring - 1% of Implementation costs	1	ls	\$0.78
	Project Management - 15% of Implementation costs	1	ls	\$11.71
	Contractor's Margin - 10% of material costs	1	ls	\$4.78
	Contingency - 15% of total costs	1	ls	\$21.10
	Contractor Project Fees Subtotal			\$40.71
	TOTAL COST PER ACRE, REPLACEMENT PLANT INSTALLATION, YEAR 5			\$161.79
2007	Maintenance of plant protectors:			
	Maintenance of plant protectors - 10% of Years 3 and 4 planting costs	1	ls	\$74.53
	Implementation subtotal			\$74.53
	Project Design and Work Plan - 3% of Implementation costs	1	ls	\$2.24
	Monitoring - 1% of Implementation costs	1	ls	\$0.75
	Project Management - 15% of Implementation costs	1	ls	\$11.18
	Contingency - 15% of total costs	1	ls	\$13.30
	Contractor Project Fees Subtotal			\$27.47
	TOTAL COST PER ACRE, MAINTENANCE OF PLANT PROTECTORS, YEAR 5			\$102.00
2007	Noxious weed control:			
	Release of beneficial insects for biological control of noxious weed species	1	ls	\$10.30
	Implementation subtotal			\$10.30
	Beneficial insects	27	carton	\$14.35
	Materials subtotal			\$14.35
	Project Design and Work Plan - 3% of Implementation costs	1	ls	\$0.31
	Monitoring - 1% of Implementation costs	1	ls	\$0.10
	Project Management - 15% of Implementation costs	1	ls	\$1.55
	Contractor's Margin - 10% of material costs	1	ls	\$1.59

8.5 Prescription: Well Vegetated (WV)

	Contingency - 15% of total costs	1	ls	\$4.23
	Contractor Project Fees Subtotal			\$7.78
	TOTAL COST PER ACRE, NOXIOUS WEED CONTROL, YEAR 5			\$32.43
	TOTAL COST PER ACRE, WELL VEGETATED (WV), YEAR 5			\$1,105.19
2008	Restoration enhancement planting:			
	Airlift planting supplies to installation sites	1	ls	\$17.52
	Plant seedlings - includes placement of amendments in planting hole and installation of tree protectors	500	seedling	\$372.66
	Implementation subtotal			\$390.18
	Containerized seedlings	500	seedlings	\$143.75
	"Bio-Pak" (16-6-8 + minors) slow release fertilizer, 1 packet/seedling	500	packet	\$7.50
	Pelletized compost - 1 pint/seedling	500	pint	\$6.48
	"Treepro Junior" - 4"x12" plant protector, 1	500	protector	\$57.50
	Materials subtotal			\$215.23
	Project Design and Work Plan - 3% of Implementation costs	1	ls	\$11.71
	Monitoring - 1% of Implementation costs	1	ls	\$3.90
	Project Management - 15% of Implementation costs	1	ls	\$58.53
	Contractor's Margin - 10% of material costs	1	ls	\$23.91
	Contingency - 15% of total costs	1	ls	\$105.52
	Contractor Project Fees Subtotal			\$203.56
	TOTAL COST PER ACRE, RESTORATION ENHANCEMENT PLANTING, YEAR 6			\$808.97
2008	Replacement plant installation:			
	Airlift replanting supplies to installation sites - 20% of Year 5 airlift costs	1	ls	\$3.50
	Plant replacement seedlings - 20% of Year 5 planting costs	1	ls	\$74.53
	Implementation subtotal			\$78.04
	Replacement containerized seedlings - 20% of Year 3 totals	1	ls	\$28.75
	Replacement plant protectors and amendments	1	ls	\$14.30
	Materials subtotal			\$43.05
	Project Design and Work Plan - 3% of Implementation costs	1	ls	\$2.34
	Monitoring - 1% of Implementation costs	1	ls	\$0.78
	Project Management - 15% of Implementation costs	1	ls	\$11.71
	Contractor's Margin - 10% of material costs	1	ls	\$4.78
	Contingency - 15% of total costs	1	ls	\$21.10
	Contractor Project Fees Subtotal			\$40.71
	TOTAL COST PER ACRE, REPLACEMENT PLANT INSTALLATION, YEAR 6			\$161.79
2008	Maintenance of plant protectors:			
	Maintenance of plant protectors - 10% of Years 4 and 5 planting costs	1	ls	\$74.53
	Implementation subtotal			\$74.53
	Project Design and Work Plan - 3% of Implementation costs	1	ls	\$2.24
	Monitoring - 1% of Implementation costs	1	ls	\$0.75
	Project Management - 15% of Implementation costs	1	ls	\$11.18
	Contingency - 15% of total costs	1	ls	\$13.30
	Contractor Project Fees Subtotal			\$27.47
	TOTAL COST PER ACRE, MAINTENANCE OF PLANT PROTECTORS, YEAR 6			\$102.00
2008	Noxious weed control:			

8.5 Prescription: Well Vegetated (WV)				
	Release of beneficial insects for biological control of noxious weed species	1	ls	\$10.30
	Implementation subtotal			\$10.30
	Beneficial insects	27	carton	\$14.35
	Materials subtotal			\$14.35
	Project Design and Work Plan - 3% of Implementation costs	1	ls	\$0.31
	Monitoring - 1% of Implementation costs	1	ls	\$0.10
	Project Management - 15% of Implementation costs	1	ls	\$1.55
	Contractor's Margin - 10% of material costs	1	ls	\$1.59
	Contingency - 15% of total costs	1	ls	\$4.23
	Contractor Project Fees Subtotal			\$7.78
	TOTAL COST PER ACRE, NOXIOUS WEED CONTROL, YEAR 6			\$32.43
	TOTAL COST PER ACRE, WELL VEGETATED (WV), YEAR 6			\$1,105.19
2009	Replacement plant installation:			
	Airlift replanting supplies to installation sites - 20% of Year 6 airlift costs	1	ls	\$3.50
	Plant replacement seedlings - 20% of Year 6 planting costs	1	ls	\$74.53
	Implementation subtotal			\$78.04
	Replacement containerized seedlings - 20% of Year 3 totals	1	ls	\$28.75
	Replacement plant protectors and amendments	1	ls	\$14.30
	Materials subtotal			\$43.05
	Project Design and Work Plan - 3% of Implementation costs	1	ls	\$2.34
	Monitoring - 1% of Implementation costs	1	ls	\$0.78
	Project Management - 15% of Implementation costs	1	ls	\$11.71
	Contractor's Margin - 10% of material costs	1	ls	\$4.78
	Contingency - 15% of total costs	1	ls	\$21.10
	Contractor Project Fees Subtotal			\$40.71
	TOTAL COST PER ACRE, REPLACEMENT PLANT INSTALLATION, YEAR 7			\$161.79
2009	Maintenance of plant protectors:			
	Maintenance of plant protectors - 10% of Years 5 and 6 planting costs	1	ls	\$74.53
	Implementation subtotal			\$74.53
	Project Design and Work Plan - 3% of Implementation costs	1	ls	\$2.24
	Monitoring - 1% of Implementation costs	1	ls	\$0.75
	Project Management - 15% of Implementation costs	1	ls	\$11.18
	Contingency - 15% of total costs	1	ls	\$13.30
	Contractor Project Fees Subtotal			\$27.47
	TOTAL COST PER ACRE, MAINTENANCE OF PLANT PROTECTORS, YEAR 7			\$102.00
2009	Noxious weed control:			
	Release of beneficial insects for biological control of noxious weed species	1	ls	\$10.30
	Implementation subtotal			\$10.30
	Beneficial insects	27	carton	\$14.35
	Materials subtotal			\$14.35
	Project Design and Work Plan - 3% of Implementation costs	1	ls	\$0.31
	Monitoring - 1% of Implementation costs	1	ls	\$0.10
	Project Management - 15% of Implementation costs	1	ls	\$1.55
	Contractor's Margin - 10% of material costs	1	ls	\$1.59
	Contingency - 15% of total costs	1	ls	\$4.23
	Contractor Project Fees Subtotal			\$7.78

8.5 Prescription: Well Vegetated (WV)

TOTAL COST PER ACRE, NOXIOUS WEED CONTROL, YEAR 7				\$32.43
TOTAL COST PER ACRE, WELL VEGETATED (WV), YEAR 7				\$296.22
2010	Maintenance of plant protectors:			
	Maintenance of plant protectors - 10% of Years 6 and 7 planting costs	1	ls	\$37.27
	Implementation subtotal			\$37.27
	Project Design and Work Plan - 3% of Implementation costs	1	ls	\$1.12
	Monitoring - 1% of Implementation costs	1	ls	\$0.37
	Project Management - 15% of Implementation costs	1	ls	\$5.59
	Contingency - 15% of total costs	1	ls	\$6.65
	Contractor Project Fees Subtotal			\$13.73
TOTAL COST PER ACRE, MAINTENANCE OF PLANT PROTECTORS, YEAR 8				\$51.00
TOTAL COST PER ACRE, WELL VEGETATED (WV), YEAR 8				\$51.00
TOTAL COST PER ACRE, WELL VEGETATED (WV), ACTIVE RESTORATION, ALL YEARS				\$4,453.17
TOTAL COST PER ACRE, WELL VEGETATED (WV), ACTIVE RESTORATION, ALL YEARS - NET PRESENT VALUE				\$3,527.47

8.6 Prescription: Tillage (T6)				
Restoration Alternative: Intensive Restoration				
Treatment Summary: Mechanical compost application/incorporation; mechanical fertilizer application - initial rate; broadcast seeding - enhanced mix; restoration enhancement planting; install plant protectors; maintenance of plant protectors; replacement plant installation; noxious weed control; aerial application of fertilizers - maintenance rate; restoration monitoring				
Year	Treatment	Rate/acre	Unit	Cost/acre
2003	Mechanical compost application/incorporation:			
	Mechanical compost application	201	cubic yard (cy)	\$2,211.00
	Mechanical compost incorporation	1	ls	\$140.00
	Implementation subtotal			\$2,351.00
	Compost	201	cy	\$2,814.00
	Materials subtotal			\$2,814.00
	Project Design and Work Plan - 3% of implementation costs	1	ls	\$70.53
	Project Management - 15% of implementation costs	1	ls	\$352.65
	Contractor's Margin - 10% of material costs	1	ls	\$312.67
	Contingency - 15% of total costs	1	ls	\$885.13
	Contractor Project Fees Subtotal			\$1,620.97
	TOTAL COST PER ACRE, MECHANICAL COMPOST APPLICATION/INCORPORATION, YEAR 1			\$6,785.97
	TOTAL COST PER ACRE, TILLAGE (T6), YEAR 1			\$6,785.97
2004	Mechanical fertilizer application - initial rate:			
	Mechanical fertilizer application	1	ton	\$40.00
	Implementation subtotal			\$40.00
	"Biosol Mix" (7-2-3) - organic fertilizer, initial rate	1	ton	\$540.00
	Materials subtotal			\$540.00
	Project Design and Work Plan - 3% of implementation costs	1	ls	\$1.20
	Project Management - 15% of implementation costs	1	ls	\$6.00
	Contractor's Margin - 10% of material costs	1	ls	\$60.00
	Contingency - 15% of total costs	1	ls	\$97.08
	Contractor Project Fees Subtotal			\$164.28
	TOTAL COST PER ACRE, MECHANICAL FERTILIZER APPLICATION - INITIAL RATE,			\$744.28
2004	Broadcast seeding - enhanced mix:			
	Broadcast seeding	4	pound	\$110.00
	Implementation subtotal			\$110.00
	Native grass/forb seed mixture	4	pound	\$72.00
	Materials subtotal			\$72.00
	Project Design and Work Plan - 3% of implementation costs	1	ls	\$3.30
	Project Management - 15% of implementation costs	1	ls	\$16.50
	Contractor's Margin - 10% of material costs	1	ls	\$8.00
	Contingency - 15% of total costs	1	ls	\$19.47
	Contractor Project Fees Subtotal			\$47.27
	TOTAL COST PER ACRE, BROADCAST SEEDING - ENHANCED MIX, YEAR 2			\$229.27
	TOTAL COST PER ACRE, TILLAGE (T6), YEAR 2			\$973.55
2005	Restoration enhancement planting:			
	Airlift planting supplies to installation sites	1	ls	\$34.83
	Plant seedlings - includes placement of amendments in planting hole and installation of tree protectors	1,000	seedling	\$745.32

8.6 Prescription: Tillage (T6)

				Implementation subtotal	\$780.15
	Containerized seedlings	1,000	seedling		\$287.50
	"Bio-Pak" (16-6-8 + minors) slow release fertilizer, 1 packet/seedling	1,000	packet		\$15.00
	Pelletized compost - 1 pint/seedling	1,000	pint		\$12.95
	"Treepro Junior" - 4"x12" plant protector, 1	1,000	protector		\$115.00
				Materials subtotal	\$430.45
	Project Design and Work Plan - 3% of implementation costs	1	ls		\$23.40
	Monitoring - 1% of implementation costs	1	ls		\$7.80
	Project Management - 15% of implementation costs	1	ls		\$117.02
	Contractor's Margin - 10% of material costs	1	ls		\$47.83
	Contingency - 15% of total costs	1	ls		\$211.00
				Contractor Project Fees Subtotal	\$407.05
TOTAL COST PER ACRE, RESTORATION ENHANCEMENT PLANTING, YEAR 3					\$1,617.66
2005	Noxious weed control:				
	Release of beneficial insects for biological control of noxious weed species	1	ls		\$10.30
				Implementation subtotal	\$10.30
	Beneficial insects	27	carton		\$14.35
				Materials subtotal	\$14.35
	Project Design and Work Plan - 3% of implementation costs	1	ls		\$0.31
	Monitoring - 1% of implementation costs	1	ls		\$0.10
	Project Management - 15% of implementation costs	1	ls		\$1.55
	Contractor's Margin - 10% of material costs	1	ls		\$1.59
	Contingency - 15% of total costs	1	ls		\$4.23
				Contractor Project Fees Subtotal	\$7.78
TOTAL COST PER ACRE, NOXIOUS WEED CONTROL, YEAR 3					\$32.43
TOTAL COST PER ACRE, TILLAGE (T6), YEAR 3					\$1,650.08
2006	Restoration enhancement planting:				
	Airlift planting supplies to installation sites	1	ls		\$34.83
	Plant seedlings - includes placement of amendments in planting hole and installation of tree protectors	1,000	seedling		\$745.32
				Implementation subtotal	\$780.15
	Containerized seedlings	1,000	seedling		\$287.50
	"Bio-Pak" (16-6-8 + minors) slow release fertilizer, 1 packet/seedling	1,000	packet		\$15.00
	Pelletized compost - 1 pint/seedling	1,000	pint		\$12.95
	"Treepro Junior" - 4"x12" plant protector, 1	1,000	protector		\$115.00
				Materials subtotal	\$430.45
	Project Design and Work Plan - 3% of implementation costs	1	ls		\$23.40
	Monitoring - 1% of implementation costs	1	ls		\$7.80
	Project Management - 15% of implementation costs	1	ls		\$117.02
	Contractor's Margin - 10% of material costs	1	ls		\$47.83
	Contingency - 15% of total costs	1	ls		\$211.00
				Contractor Project Fees Subtotal	\$407.05
TOTAL COST PER ACRE, RESTORATION ENHANCEMENT PLANTING, YEAR 4					\$1,617.66
2006	Replacement plant installation:				
	Airlift replanting supplies to installation sites - 20% of Year 3 airlift costs	1	ls		\$6.97
	Plant replacement seedlings - 20% of Year 3 planting costs	1	ls		\$149.06

8.6 Prescription: Tillage (T6)

Implementation subtotal				\$156.03
Replacement containerized seedlings - 20% of Year 3 totals	1	ls		\$57.50
Replacement plant protectors and amendments	1	ls		\$28.59
Materials subtotal				\$86.09
Project Design and Work Plan - 3% of implementation costs	1	ls		\$4.68
Monitoring - 1% of implementation costs	1	ls		\$1.56
Project Management - 15% of implementation costs	1	ls		\$23.40
Contractor's Margin - 10% of material costs	1	ls		\$9.57
Contingency - 15% of total costs	1	ls		\$42.20
Contractor Project Fees Subtotal				\$81.41
TOTAL COST PER ACRE, REPLACEMENT PLANT INSTALLATION, YEAR 4				\$323.53
2006 Maintenance of plant protectors:				
Maintenance of plant protectors - 10% of Year 3 planting costs	1	ls		\$74.53
Implementation subtotal				\$74.53
Project Design and Work Plan - 3% of implementation costs	1	ls		\$2.24
Monitoring - 1% of implementation costs	1	ls		\$0.75
Project Management - 15% of implementation costs	1	ls		\$11.18
Contingency - 15% of total costs	1	ls		\$13.30
Contractor Project Fees Subtotal				\$27.47
TOTAL COST PER ACRE, MAINTENANCE OF PLANT PROTECTORS, YEAR 4				\$102.00
2006 Noxious weed control:				
Release of beneficial insects for biological control of noxious weed species	1	ls		\$10.30
Implementation subtotal				\$10.30
Beneficial insects	27	carton		\$14.35
Materials subtotal				\$14.35
Project Design and Work Plan - 3% of implementation costs	1	ls		\$0.31
Monitoring - 1% of implementation costs	1	ls		\$0.10
Project Management - 15% of implementation costs	1	ls		\$1.55
Contractor's Margin - 10% of material costs	1	ls		\$1.59
Contingency - 15% of total costs	1	ls		\$4.23
Contractor Project Fees Subtotal				\$7.78
TOTAL COST PER ACRE, NOXIOUS WEED CONTROL, YEAR 4				\$32.43
TOTAL COST PER ACRE, TILLAGE (T6), YEAR 4				\$2,075.61
2007 Restoration enhancement planting:				
Airlift planting supplies to installation sites	1	ls		\$34.83
Plant seedlings - includes placement of amendments in planting hole and installation of tree protectors	1,000	seedling		\$745.32
Implementation subtotal				\$780.15
Containerized seedlings	1,000	seedling		\$287.50
"Bio-Pak" (16-6-8 + minors) slow release fertilizer, 1 packet/seedling	1,000	packet		\$15.00
Pelletized compost - 1 pint/seedling	1,000	pint		\$12.95
"Treepro Junior" - 4"x12" plant protector, 1	1,000	protector		\$115.00
Materials subtotal				\$430.45
Project Design and Work Plan - 3% of implementation costs	1	ls		\$23.40
Monitoring - 1% of implementation costs	1	ls		\$7.80
Project Management - 15% of implementation costs	1	ls		\$117.02
Contractor's Margin - 10% of material costs	1	ls		\$47.83

8.6 Prescription: Tillage (T6)

	Contingency - 15% of total costs	1	ls	\$211.00
	Contractor Project Fees Subtotal			\$407.05
	TOTAL COST PER ACRE, RESTORATION ENHANCEMENT PLANTING, YEAR 5			\$1,617.66
2007	Replacement plant installation:			
	Airlift replanting supplies to installation sites - 20% of Year 4 airlift costs	1	ls	\$6.97
	Plant replacement seedlings - 20% of Year 4 planting costs	1	ls	\$149.06
	Implementation subtotal			\$156.03
	Replacement containerized seedlings - 20% of Year 3 totals	1	ls	\$57.50
	Replacement plant protectors and amendments	1	ls	\$28.59
	Materials subtotal			\$86.09
	Project Design and Work Plan - 3% of implementation costs	1	ls	\$4.68
	Monitoring - 1% of implementation costs	1	ls	\$1.56
	Project Management - 15% of implementation costs	1	ls	\$23.40
	Contractor's Margin - 10% of material costs	1	ls	\$9.57
	Contingency - 15% of total costs	1	ls	\$42.20
	Contractor Project Fees Subtotal			\$81.41
	TOTAL COST PER ACRE, REPLACEMENT PLANT INSTALLATION, YEAR 5			\$323.53
2007	Maintenance of plant protectors:			
	Maintenance of plant protectors - 10% of Years 3 and 4 planting costs	1	ls	\$149.06
	Implementation subtotal			\$149.06
	Project Design and Work Plan - 3% of implementation costs	1	ls	\$4.47
	Monitoring - 1% of implementation costs	1	ls	\$1.49
	Project Management - 15% of implementation costs	1	ls	\$22.36
	Contingency - 15% of total costs	1	ls	\$26.61
	Contractor Project Fees Subtotal			\$54.93
	TOTAL COST PER ACRE, MAINTENANCE OF PLANT PROTECTORS, YEAR 5			\$203.99
2007	Noxious weed control:			
	Release of beneficial insects for biological control of noxious weed species	1	ls	\$10.30
	Implementation subtotal			\$10.30
	Beneficial insects	27	carton	\$14.35
	Materials subtotal			\$14.35
	Project Design and Work Plan - 3% of implementation costs	1	ls	\$0.31
	Monitoring - 1% of implementation costs	1	ls	\$0.10
	Project Management - 15% of implementation costs	1	ls	\$1.55
	Contractor's Margin - 10% of material costs	1	ls	\$1.59
	Contingency - 15% of total costs	1	ls	\$4.23
	Contractor Project Fees Subtotal			\$7.78
	TOTAL COST PER ACRE, NOXIOUS WEED CONTROL, YEAR 5			\$32.43
	TOTAL COST PER ACRE, TILLAGE (T6), YEAR 5			\$2,177.61
2008	Restoration enhancement planting:			
	Airlift planting supplies to installation sites	1	ls	\$34.83
	Plant seedlings - includes placement of amendments in planting hole and installation of tree protectors	1,000	seedling	\$745.32
	Implementation subtotal			\$780.15
	Containerized seedlings	1,000	seedling	\$287.50

8.6 Prescription: Tillage (T6)

	"Bio-Pak" (16-6-8 + minors) slow release fertilizer, 1 packet/seedling	1,000	packet	\$15.00
	Pelletized compost - 1 pint/seedling	1,000	pint	\$12.95
	"Treepro Junior" - 4"x12" plant protector, 1	1,000	protector	\$115.00
	Materials subtotal			\$430.45
	Project Design and Work Plan - 3% of implementation costs	1	ls	\$23.40
	Monitoring - 1% of implementation costs	1	ls	\$7.80
	Project Management - 15% of implementation costs	1	ls	\$117.02
	Contractor's Margin - 10% of material costs	1	ls	\$47.83
	Contingency - 15% of total costs	1	ls	\$211.00
	Contractor Project Fees Subtotal			\$407.05
	TOTAL COST PER ACRE, RESTORATION ENHANCEMENT PLANTING, YEAR 6			\$1,617.66
2008	Replacement plant installation:			
	Airlift replanting supplies to installation sites - 20% of Year 5 airlift costs	1	ls	\$6.97
	Plant replacement seedlings - 20% of Year 5 planting costs	1	ls	\$149.06
	Implementation subtotal			\$156.03
	Replacement containerized seedlings - 20% of Year 3 totals	1	ls	\$57.50
	Replacement plant protectors and amendments	1	ls	\$28.59
	Materials subtotal			\$86.09
	Project Design and Work Plan - 3% of implementation costs	1	ls	\$4.68
	Monitoring - 1% of implementation costs	1	ls	\$1.56
	Project Management - 15% of implementation costs	1	ls	\$23.40
	Contractor's Margin - 10% of material costs	1	ls	\$9.57
	Contingency - 15% of total costs	1	ls	\$42.20
	Contractor Project Fees Subtotal			\$81.41
	TOTAL COST PER ACRE, REPLACEMENT PLANT INSTALLATION, YEAR 6			\$323.53
2008	Maintenance of plant protectors:			
	Maintenance of plant protectors - 10% of Years 4 and 5 planting costs	1	ls	\$149.06
	Implementation subtotal			\$149.06
	Project Design and Work Plan - 3% of implementation costs	1	ls	\$4.47
	Monitoring - 1% of implementation costs	1	ls	\$1.49
	Project Management - 15% of implementation costs	1	ls	\$22.36
	Contingency - 15% of total costs	1	ls	\$26.61
	Contractor Project Fees Subtotal			\$54.93
	TOTAL COST PER ACRE, MAINTENANCE OF PLANT PROTECTORS, YEAR 6			\$203.99
2008	Aerial application of fertilizer - maintenance rate:			
	Aerial fertilization - dry application, maintenance rate	1	ls	\$220.60
	Implementation subtotal			\$220.60
	"Biosol Mix" (7-2-3) - organic fertilizer, maintenance rate	0.5	ton	\$310.50
	Materials subtotal			\$310.50
	Project Design and Work Plan - 3% of implementation costs	1	ls	\$6.62
	Monitoring - 1.5% of implementation costs	1	ls	\$2.21
	Project Management - 15% of implementation costs	1	ls	\$33.09
	Contractor's Margin - 10% of material costs	1	ls	\$34.50
	Contingency - 15% of total costs	1	ls	\$91.13
	Contractor Project Fees Subtotal			\$167.54
	TOTAL COST PER ACRE, AERIAL APPLICATION OF FERTILIZER - MAINTENANCE RATE, YEAR 6			\$692.02

8.6 Prescription: Tillage (T6)

2008 Noxious weed control:				
Release of beneficial insects for biological control of noxious	1	ls		\$10.30
Implementation subtotal				\$10.30
Beneficial insects	27	carton		\$14.35
Materials subtotal				\$14.35
Project Design and Work Plan - 3% of implementation costs	1	ls		\$0.31
Monitoring - 1% of implementation costs	1	ls		\$0.10
Project Management - 15% of implementation costs	1	ls		\$1.55
Contractor's Margin - 10% of material costs	1	ls		\$1.59
Contingency - 15% of total costs	1	ls		\$4.23
Contractor Project Fees Subtotal				\$7.78
TOTAL COST PER ACRE, NOXIOUS WEED CONTROL, YEAR 6				\$32.43
TOTAL COST PER ACRE, TILLAGE (T6), YEAR 6				\$2,869.63
2009 Replacement plant installation:				
Airlift replanting supplies to installation sites - 20% of Year 6	1	ls		\$6.97
airlift costs				
Plant replacement seedlings - 20% of Year 6 planting costs	1	ls		\$149.06
Implementation subtotal				\$156.03
Replacement containerized seedlings - 20% of Year 3 totals	1	ls		\$57.50
Replacement plant protectors and amendments	1	ls		\$28.59
Materials subtotal				\$86.09
Project Design and Work Plan - 3% of implementation costs	1	ls		\$4.68
Monitoring - 1% of implementation costs	1	ls		\$1.56
Project Management - 15% of implementation costs	1	ls		\$23.40
Contractor's Margin - 10% of material costs	1	ls		\$9.57
Contingency - 15% of total costs	1	ls		\$42.20
Contractor Project Fees Subtotal				\$81.41
TOTAL COST PER ACRE, REPLACEMENT PLANT INSTALLATION, YEAR 7				\$323.53
2009 Maintenance of plant protectors:				
Maintenance of plant protectors - 10% of Years 5 and 6	1	ls		\$149.06
planting costs				
Implementation subtotal				\$149.06
Project Design and Work Plan - 3% of implementation costs	1	ls		\$4.47
Monitoring - 1% of implementation costs	1	ls		\$1.49
Project Management - 15% of implementation costs	1	ls		\$22.36
Contingency - 15% of total costs	1	ls		\$26.61
Contractor Project Fees Subtotal				\$54.93
TOTAL COST PER ACRE, MAINTENANCE OF PLANT PROTECTORS, YEAR 7				\$203.99
2009 Noxious weed control:				
Release of beneficial insects for biological control of noxious	1	ls		\$10.30
weed species				
Implementation subtotal				\$10.30
Beneficial insects	27	carton		\$14.35
Materials subtotal				\$14.35
Project Design and Work Plan - 3% of implementation costs	1	ls		\$0.31
Monitoring - 1% of implementation costs	1	ls		\$0.10
Project Management - 15% of implementation costs	1	ls		\$1.55
Contractor's Margin - 10% of material costs	1	ls		\$1.59
Contingency - 15% of total costs	1	ls		\$4.23

8.6 Prescription: Tillage (T6)

Contractor Project Fees Subtotal				\$7.78
TOTAL COST PER ACRE, NOXIOUS WEED CONTROL, YEAR 7				\$32.43
TOTAL COST PER ACRE, TILLAGE (T6), YEAR 7				\$559.95
2010	Maintenance of plant protectors:			
	Maintenance of plant protectors - 10% of Years 6 and 7 planting costs	1	Is	\$74.53
	Implementation subtotal			\$74.53
	Project Design and Work Plan - 3% of implementation costs	1	Is	\$2.24
	Monitoring - 1% of implementation costs	1	Is	\$0.75
	Project Management - 15% of implementation costs	1	Is	\$11.18
	Contingency - 15% of total costs	1	Is	\$13.30
	Contractor Project Fees Subtotal			\$27.47
	TOTAL COST PER ACRE, MAINTENANCE OF PLANT PROTECTORS, YEAR 8			
TOTAL COST PER ACRE, TILLAGE (T6), YEAR 8				\$102.00
TOTAL COST PER ACRE, TILLAGE (T6), INTENSIVE RESTORATION, ALL YEARS				\$17,194.41
TOTAL COST PER ACRE, TILLAGE (T6), INTENSIVE RESTORATION, ALL YEARS - NET PRESENT VALUE				\$14,420.76

Prescription: Tillage (T12)				
Restoration Alternative: Intensive Restoration				
Treatment Summary: Mechanical compost application/incorporation; mechanical fertilizer application - initial rate; broadcast seeding - enhanced mix; restoration enhancement planting; install plant protectors; maintenance of plant protectors; replacement plant installation; noxious weed control; aerial application of fertilizers - maintenance rate; restoration monitoring				
Year	Treatment	Rate/acre	Unit	Cost/acre
2003	Mechanical compost application/incorporation:			
	Mechanical compost application	403	cubic yard (cy)	\$4,433.00
	Mechanical compost incorporation	1	ls	\$140.00
	Implementation subtotal			\$4,573.00
	Compost	403	cy	\$5,642.00
	Materials subtotal			\$5,642.00
	Project Design and Work Plan - 3% of implementation costs	1	ls	\$137.19
	Project Management - 15% of implementation costs	1	ls	\$685.95
	Contractor's Margin - 10% of material costs	1	ls	\$626.89
	Contingency - 15% of total costs	1	ls	\$1,749.75
	Contractor Project Fees Subtotal			\$3,199.78
	TOTAL COST PER ACRE, MECHANICAL COMPOST APPLICATION/INCORPORATION, YEAR 1			\$13,414.78
	TOTAL COST PER ACRE, TILLAGE (T12), YEAR 1			\$13,414.78
2004	Mechanical fertilizer application - initial rate:			
	Mechanical fertilizer application	1	ton	\$40.00
	Implementation subtotal			\$40.00
	"Biosol Mix" (7-2-3) - organic fertilizer, initial rate	1	ton	\$540.00
	Materials subtotal			\$540.00
	Project Design and Work Plan - 3% of implementation costs	1	ls	\$1.20
	Project Management - 15% of implementation costs	1	ls	\$6.00
	Contractor's Margin - 10% of material costs	1	ls	\$60.00
	Contingency - 15% of total costs	1	ls	\$97.08
	Contractor Project Fees Subtotal			\$164.28
	TOTAL COST PER ACRE, MECHANICAL FERTILIZER APPLICATION - INITIAL RATE,			\$744.28
2004	Broadcast seeding - enhanced mix:			
	Broadcast seeding	4	pound	\$110.00
	Implementation subtotal			\$110.00
	Native grass/forb seed mixture	4	pound	\$72.00
	Materials subtotal			\$72.00
	Project Design and Work Plan - 3% of implementation costs	1	ls	\$3.30
	Project Management - 15% of implementation costs	1	ls	\$16.50
	Contractor's Margin - 10% of material costs	1	ls	\$8.00
	Contingency - 15% of total costs	1	ls	\$19.47
	Contractor Project Fees Subtotal			\$47.27
	TOTAL COST PER ACRE, BROADCAST SEEDING - ENHANCED MIX, YEAR 2			\$229.27
	TOTAL COST PER ACRE, TILLAGE (T12), YEAR 2			\$973.55
2005	Restoration enhancement planting:			
	Airlift planting supplies to installation sites	1	ls	\$34.83
	Plant seedlings - includes placement of amendments in planting hole and installation of tree protectors	1,000	seedling	\$745.32

Prescription: Tillage (T12)				
	Implementation subtotal			\$780.15
Containerized seedlings	1,000	seedling		\$287.50
"Bio-Pak" (16-6-8 + minors) slow release fertilizer, 1 packet/seedling	1,000	packet		\$15.00
Pelletized compost - 1 pint/seedling	1,000	pint		\$12.95
"Treepro Junior" - 4"x12" plant protector, 1	1,000	protector		\$115.00
	Materials subtotal			\$430.45
Project Design and Work Plan - 3% of implementation costs	1	ls		\$23.40
Monitoring - 1% of implementation costs	1	ls		\$7.80
Project Management - 15% of implementation costs	1	ls		\$117.02
Contractor's Margin - 10% of material costs	1	ls		\$47.83
Contingency - 15% of total costs	1	ls		\$211.00
	Contractor Project Fees Subtotal			\$407.05
TOTAL COST PER ACRE, RESTORATION ENHANCEMENT PLANTING, YEAR 3				\$1,617.66
2005 Noxious weed control:				
Release of beneficial insects for biological control of noxious weed species	1	ls		\$10.30
	Implementation subtotal			\$10.30
Beneficial insects	27	carton		\$14.35
	Materials subtotal			\$14.35
Project Design and Work Plan - 3% of implementation costs	1	ls		\$0.31
Monitoring - 1% of implementation costs	1	ls		\$0.10
Project Management - 15% of implementation costs	1	ls		\$1.55
Contractor's Margin - 10% of material costs	1	ls		\$1.59
Contingency - 15% of total costs	1	ls		\$4.23
	Contractor Project Fees Subtotal			\$7.78
TOTAL COST PER ACRE, NOXIOUS WEED CONTROL, YEAR 3				\$32.43
TOTAL COST PER ACRE, TILLAGE (T12), YEAR 3				\$1,650.08
2006 Restoration enhancement planting:				
Airlift planting supplies to installation sites	1	ls		\$34.83
Plant seedlings - includes placement of amendments in planting hole and installation of tree protectors	1,000	seedling		\$745.32
	Implementation subtotal			\$780.15
Containerized seedlings	1,000	seedling		\$287.50
"Bio-Pak" (16-6-8 + minors) slow release fertilizer, 1 packet/seedling	1,000	packet		\$15.00
Pelletized compost - 1 pint/seedling	1,000	pint		\$12.95
"Treepro Junior" - 4"x12" plant protector, 1	1,000	protector		\$115.00
	Materials subtotal			\$430.45
Project Design and Work Plan - 3% of implementation costs	1	ls		\$23.40
Monitoring - 1% of implementation costs	1	ls		\$7.80
Project Management - 15% of implementation costs	1	ls		\$117.02
Contractor's Margin - 10% of material costs	1	ls		\$47.83
Contingency - 15% of total costs	1	ls		\$211.00
	Contractor Project Fees Subtotal			\$407.05
TOTAL COST PER ACRE, RESTORATION ENHANCEMENT PLANTING, YEAR 4				\$1,617.66
2006 Replacement plant installation:				
Airlift replanting supplies to installation sites - 20% of Year 3 airlift costs	1	ls		\$6.97
Plant replacement seedlings - 20% of Year 3 planting costs	1	ls		\$149.06

Prescription: Tillage (T12)			
	Implementation subtotal		\$156.03
Replacement containerized seedlings - 20% of Year 3 totals	1	ls	\$57.50
Replacement plant protectors and amendments	1	ls	\$28.59
	Materials subtotal		\$86.09
Project Design and Work Plan - 3% of implementation costs	1	ls	\$4.68
Monitoring - 1% of implementation costs	1	ls	\$1.56
Project Management - 15% of implementation costs	1	ls	\$23.40
Contractor's Margin - 10% of material costs	1	ls	\$9.57
Contingency - 15% of total costs	1	ls	\$42.20
	Contractor Project Fees Subtotal		\$81.41
TOTAL COST PER ACRE, REPLACEMENT PLANT INSTALLATION, YEAR 4			\$323.53
2006 Maintenance of plant protectors:			
Maintenance of plant protectors - 10% of Year 3 planting costs	1	ls	\$74.53
	Implementation subtotal		\$74.53
Project Design and Work Plan - 3% of implementation costs	1	ls	\$2.24
Monitoring - 1% of implementation costs	1	ls	\$0.75
Project Management - 15% of implementation costs	1	ls	\$11.18
Contingency - 15% of total costs	1	ls	\$13.30
	Contractor Project Fees Subtotal		\$27.47
TOTAL COST PER ACRE, MAINTENANCE OF PLANT PROTECTORS, YEAR 4			\$102.00
2006 Noxious weed control:			
Release of beneficial insects for biological control of noxious weed species	1	ls	\$10.30
	Implementation subtotal		\$10.30
Beneficial insects	27	carton	\$14.35
	Materials subtotal		\$14.35
Project Design and Work Plan - 3% of implementation costs	1	ls	\$0.31
Monitoring - 1% of implementation costs	1	ls	\$0.10
Project Management - 15% of implementation costs	1	ls	\$1.55
Contractor's Margin - 10% of material costs	1	ls	\$1.59
Contingency - 15% of total costs	1	ls	\$4.23
	Contractor Project Fees Subtotal		\$7.78
TOTAL COST PER ACRE, NOXIOUS WEED CONTROL, YEAR 4			\$32.43
TOTAL COST PER ACRE, TILLAGE (T12), YEAR 4			\$2,075.61
2007 Restoration enhancement planting:			
Airlift planting supplies to installation sites	1	ls	\$34.83
Plant seedlings - includes placement of amendments in planting hole and installation of tree protectors	1,000	seedling	\$745.32
	Implementation subtotal		\$780.15
Containerized seedlings	1,000	seedling	\$287.50
"Bio-Pak" (16-6-8 + minors) slow release fertilizer, 1 packet/seedling	1,000	packet	\$15.00
Pelletized compost - 1 pint/seedling	1,000	pint	\$12.95
"Treepro Junior" - 4"x12" plant protector, 1	1,000	protector	\$115.00
	Materials subtotal		\$430.45
Project Design and Work Plan - 3% of implementation costs	1	ls	\$23.40
Monitoring - 1% of implementation costs	1	ls	\$7.80
Project Management - 15% of implementation costs	1	ls	\$117.02
Contractor's Margin - 10% of material costs	1	ls	\$47.83

Prescription: Tillage (T12)			
	Contingency - 15% of total costs	1	Is \$211.00
	Contractor Project Fees Subtotal		\$407.05
	TOTAL COST PER ACRE, RESTORATION ENHANCEMENT PLANTING, YEAR 5		\$1,617.66
2007	Replacement plant installation:		
	Airlift replanting supplies to installation sites - 20% of Year 4 airlift costs	1	Is \$6.97
	Plant replacement seedlings - 20% of Year 4 planting costs	1	Is \$149.06
	Implementation subtotal		\$156.03
	Replacement containerized seedlings - 20% of Year 3 totals	1	Is \$57.50
	Replacement plant protectors and amendments	1	Is \$28.59
	Materials subtotal		\$86.09
	Project Design and Work Plan - 3% of implementation costs	1	Is \$4.68
	Monitoring - 1% of implementation costs	1	Is \$1.56
	Project Management - 15% of implementation costs	1	Is \$23.40
	Contractor's Margin - 10% of material costs	1	Is \$9.57
	Contingency - 15% of total costs	1	Is \$42.20
	Contractor Project Fees Subtotal		\$81.41
	TOTAL COST PER ACRE, REPLACEMENT PLANT INSTALLATION, YEAR 5		\$323.53
2007	Maintenance of plant protectors:		
	Maintenance of plant protectors - 10% of Years 3 and 4 planting costs	1	Is \$149.06
	Implementation subtotal		\$149.06
	Project Design and Work Plan - 3% of implementation costs	1	Is \$4.47
	Monitoring - 1% of implementation costs	1	Is \$1.49
	Project Management - 15% of implementation costs	1	Is \$22.36
	Contingency - 15% of total costs	1	Is \$26.61
	Contractor Project Fees Subtotal		\$54.93
	TOTAL COST PER ACRE, MAINTENANCE OF PLANT PROTECTORS, YEAR 5		\$203.99
2007	Noxious weed control:		
	Release of beneficial insects for biological control of noxious weed species	1	Is \$10.30
	Implementation subtotal		\$10.30
	Beneficial insects	27	carton \$14.35
	Materials subtotal		\$14.35
	Project Design and Work Plan - 3% of implementation costs	1	Is \$0.31
	Monitoring - 1% of implementation costs	1	Is \$0.10
	Project Management - 15% of implementation costs	1	Is \$1.55
	Contractor's Margin - 10% of material costs	1	Is \$1.59
	Contingency - 15% of total costs	1	Is \$4.23
	Contractor Project Fees Subtotal		\$7.78
	TOTAL COST PER ACRE, NOXIOUS WEED CONTROL, YEAR 5		\$32.43
	TOTAL COST PER ACRE, TILLAGE (T12), YEAR 5		\$2,177.61
2008	Restoration enhancement planting:		
	Airlift planting supplies to installation sites	1	Is \$34.83
	Plant seedlings - includes placement of amendments in planting hole and installation of tree protectors	1,000	seedling \$745.32
	Implementation subtotal		\$780.15
	Containerized seedlings	1,000	seedling \$287.50

Prescription: Tillage (T12)			
"Bio-Pak" (16-6-8 + minors) slow release fertilizer, 1 packet/seedling	1,000	packet	\$15.00
Pelletized compost - 1 pint/seedling	1,000	pint	\$12.95
"Treepro Junior" - 4"x12" plant protector, 1	1,000	protector	\$115.00
Materials subtotal			\$430.45
Project Design and Work Plan - 3% of implementation costs	1	ls	\$23.40
Monitoring - 1% of implementation costs	1	ls	\$7.80
Project Management - 15% of implementation costs	1	ls	\$117.02
Contractor's Margin - 10% of material costs	1	ls	\$47.83
Contingency - 15% of total costs	1	ls	\$211.00
Contractor Project Fees Subtotal			\$407.05
TOTAL COST PER ACRE, RESTORATION ENHANCEMENT PLANTING, YEAR 6			\$1,617.66
2008 Replacement plant installation:			
Airlift replanting supplies to installation sites - 20% of Year 5 airlift costs	1	ls	\$6.97
Plant replacement seedlings - 20% of Year 5 planting costs	1	ls	\$149.06
Implementation subtotal			\$156.03
Replacement containerized seedlings - 20% of Year 3 totals	1	ls	\$57.50
Replacement plant protectors and amendments	1	ls	\$28.59
Materials subtotal			\$86.09
Project Design and Work Plan - 3% of implementation costs	1	ls	\$4.68
Monitoring - 1% of implementation costs	1	ls	\$1.56
Project Management - 15% of implementation costs	1	ls	\$23.40
Contractor's Margin - 10% of material costs	1	ls	\$9.57
Contingency - 15% of total costs	1	ls	\$42.20
Contractor Project Fees Subtotal			\$81.41
TOTAL COST PER ACRE, REPLACEMENT PLANT INSTALLATION, YEAR 6			\$323.53
2008 Maintenance of plant protectors:			
Maintenance of plant protectors - 10% of Years 4 and 5 planting costs	1	ls	\$149.06
Implementation subtotal			\$149.06
Project Design and Work Plan - 3% of implementation costs	1	ls	\$4.47
Monitoring - 1% of implementation costs	1	ls	\$1.49
Project Management - 15% of implementation costs	1	ls	\$22.36
Contingency - 15% of total costs	1	ls	\$26.61
Contractor Project Fees Subtotal			\$54.93
TOTAL COST PER ACRE, MAINTENANCE OF PLANT PROTECTORS, YEAR 6			\$203.99
2008 Aerial application of fertilizer - maintenance rate:			
Aerial fertilization - dry application, maintenance rate	1	ls	\$220.60
Implementation subtotal			\$220.60
"Biosol Mix" (7-2-3) - organic fertilizer, maintenance rate	0.5	ton	\$310.50
Materials subtotal			\$310.50
Project Design and Work Plan - 3% of implementation costs	1	ls	\$6.62
Monitoring - 1.5% of implementation costs	1	ls	\$2.21
Project Management - 15% of implementation costs	1	ls	\$33.09
Contractor's Margin - 10% of material costs	1	ls	\$34.50
Contingency - 15% of total costs	1	ls	\$91.13
Contractor Project Fees Subtotal			\$167.54
TOTAL COST PER ACRE, AERIAL APPLICATION OF FERTILIZER - MAINTENANCE RATE, YEAR 6			\$692.02

Prescription: Tillage (T12)

2008	Noxious weed control:			
	Release of beneficial insects for biological control of noxious	1	ls	\$10.30
	Implementation subtotal			\$10.30
	Beneficial insects	27	carton	\$14.35
	Materials subtotal			\$14.35
	Project Design and Work Plan - 3% of implementation costs	1	ls	\$0.31
	Monitoring - 1% of implementation costs	1	ls	\$0.10
	Project Management - 15% of implementation costs	1	ls	\$1.55
	Contractor's Margin - 10% of material costs	1	ls	\$1.59
	Contingency - 15% of total costs	1	ls	\$4.23
	Contractor Project Fees Subtotal			\$7.78
	TOTAL COST PER ACRE, NOXIOUS WEED CONTROL, YEAR 6			\$32.43
	TOTAL COST PER ACRE, TILLAGE (T12), YEAR 6			\$2,869.63
2009	Replacement plant installation:			
	Airlift replanting supplies to installation sites - 20% of Year 6	1	ls	\$6.97
	airlift costs			
	Plant replacement seedlings - 20% of Year 6 planting costs	1	ls	\$149.06
	Implementation subtotal			\$156.03
	Replacement containerized seedlings - 20% of Year 3 totals	1	ls	\$57.50
	Replacement plant protectors and amendments	1	ls	\$28.59
	Materials subtotal			\$86.09
	Project Design and Work Plan - 3% of implementation costs	1	ls	\$4.68
	Monitoring - 1% of implementation costs	1	ls	\$1.56
	Project Management - 15% of implementation costs	1	ls	\$23.40
	Contractor's Margin - 10% of material costs	1	ls	\$9.57
	Contingency - 15% of total costs	1	ls	\$42.20
	Contractor Project Fees Subtotal			\$81.41
	TOTAL COST PER ACRE, REPLACEMENT PLANT INSTALLATION, YEAR 7			\$323.53
2009	Maintenance of plant protectors:			
	Maintenance of plant protectors - 10% of Years 5 and 6	1	ls	\$149.06
	planting costs			
	Implementation subtotal			\$149.06
	Project Design and Work Plan - 3% of implementation costs	1	ls	\$4.47
	Monitoring - 1% of implementation costs	1	ls	\$1.49
	Project Management - 15% of implementation costs	1	ls	\$22.36
	Contingency - 15% of total costs	1	ls	\$26.61
	Contractor Project Fees Subtotal			\$54.93
	TOTAL COST PER ACRE, MAINTENANCE OF PLANT PROTECTORS, YEAR 7			\$203.99
2009	Noxious weed control:			
	Release of beneficial insects for biological control of noxious	1	ls	\$10.30
	weed species			
	Implementation subtotal			\$10.30
	Beneficial insects	27	carton	\$14.35
	Materials subtotal			\$14.35
	Project Design and Work Plan - 3% of implementation costs	1	ls	\$0.31
	Monitoring - 1% of implementation costs	1	ls	\$0.10
	Project Management - 15% of implementation costs	1	ls	\$1.55
	Contractor's Margin - 10% of material costs	1	ls	\$1.59
	Contingency - 15% of total costs	1	ls	\$4.23

Prescription: Tillage (T12)				
Contractor Project Fees Subtotal				\$7.78
TOTAL COST PER ACRE, NOXIOUS WEED CONTROL, YEAR 7				\$32.43
TOTAL COST PER ACRE, TILLAGE (T12), YEAR 7				\$559.95
2010	Maintenance of plant protectors:			
	Maintenance of plant protectors - 10% of Years 6 and 7 planting costs	1	Is	\$74.53
	Implementation subtotal			\$74.53
	Project Design and Work Plan - 3% of implementation costs	1	Is	\$2.24
	Monitoring - 1% of implementation costs	1	Is	\$0.75
	Project Management - 15% of implementation costs	1	Is	\$11.18
	Contingency - 15% of total costs	1	Is	\$13.30
	Contractor Project Fees Subtotal			\$27.47
TOTAL COST PER ACRE, MAINTENANCE OF PLANT PROTECTORS, YEAR 8				\$102.00
TOTAL COST PER ACRE, TILLAGE (T12), YEAR 8				\$102.00
TOTAL COST PER ACRE, TILLAGE (T12), INTENSIVE RESTORATION, ALL YEARS				\$23,823.22
TOTAL COST PER ACRE, TILLAGE (T12), INTENSIVE RESTORATION, ALL YEARS - NET PRESENT VALUE				\$20,399.57

Prescription: Vegetation Improvement (VI)				
Restoration Alternative: Intensive Restoration				
Treatment Summary: Mechanical compost application - surface; broadcast seeding - enhanced mix; restoration enhancement planting; install plant protectors; maintenance of plant protectors; replacement plant installation; noxious weed control; aerial application of fertilizers - maintenance rate; restoration monitoring				
Year	Treatment	Rate/acre	Unit	Cost/acre
2003	TOTAL COST PER ACRE, VEGETATION IMPROVEMENT (VI), YEAR 1			\$0.00
2004	Broadcast seeding - enhanced mix:			
	Broadcast seeding	4	pound	\$110.00
	Implementation subtotal			\$110.00
	Native grass/forb seed mixture	4	pound	\$72.00
	Materials subtotal			\$72.00
	Project Design and Work Plan - 3% of implementation costs	1	ls	\$3.30
	Project Management - 15% of implementation costs	1	ls	\$16.50
	Contractor's Margin - 10% of material costs	1	ls	\$8.00
	Contingency - 15% of total costs	1	ls	\$19.47
	Contractor Project Fees Subtotal			\$47.27
	TOTAL COST PER ACRE, BROADCAST SEEDING - ENHANCED MIX, YEAR 2			\$229.27
2004	Mechanical compost application - surface:			
	Mechanical compost application	34	cubic yard (cy)	\$374.00
	Implementation subtotal			\$374.00
	Compost	34	cy	\$476.00
	Materials subtotal			\$476.00
	Project Design and Work Plan - 3% of implementation costs	1	ls	\$11.22
	Project Management - 15% of implementation costs	1	ls	\$56.10
	Contractor's Margin - 10% of material costs	1	ls	\$52.89
	Contingency - 15% of total costs	1	ls	\$145.53
	Contractor Project Fees Subtotal			\$265.74
	TOTAL COST PER ACRE, MECHANICAL COMPOST APPLICATION - SURFACE, YEAR			\$1,115.74
	TOTAL COST PER ACRE, VEGETATION IMPROVEMENT (VI), YEAR 2			\$1,345.01
2005	Restoration enhancement planting:			
	Airlift planting supplies to installation sites	1	ls	\$34.83
	Plant seedlings - includes placement of amendments in planting hole and installation of tree protectors	1,000	seedling	\$745.32
	Implementation subtotal			\$780.15
	Containerized seedlings	1,000	seedling	\$287.50
	"Bio-Pak" (16-6-8 + minors) slow release fertilizer, 1 packet/seedling	1,000	packet	\$15.00
	Pelletized compost - 1 pint/seedling	1,000	pint	\$12.95
	"Treepro Junior" - 4"x12" plant protector, 1	1,000	protector	\$115.00
	Materials subtotal			\$430.45
	Project Design and Work Plan - 3% of implementation costs	1	ls	\$23.40
	Monitoring - 1% of implementation costs	1	ls	\$7.80
	Project Management - 15% of implementation costs	1	ls	\$117.02
	Contractor's Margin - 10% of material costs	1	ls	\$47.83
	Contingency - 15% of total costs	1	ls	\$211.00
	Contractor Project Fees Subtotal			\$407.05
	TOTAL COST PER ACRE, RESTORATION ENHANCEMENT PLANTING, YEAR 3			\$1,617.66

Prescription: Vegetation Improvement (VI)				
2005	Noxious weed control:			
	Release of beneficial insects for biological control of noxious weed species	1	ls	\$10.30
	Implementation subtotal			\$10.30
	Beneficial insects	27	carton	\$14.35
	Materials subtotal			\$14.35
	Project Design and Work Plan - 3% of implementation costs	1	ls	\$0.31
	Monitoring - 1% of implementation costs	1	ls	\$0.10
	Project Management - 15% of implementation costs	1	ls	\$1.55
	Contractor's Margin - 10% of material costs	1	ls	\$1.59
	Contingency - 15% of total costs	1	ls	\$4.23
	Contractor Project Fees Subtotal			\$7.78
	TOTAL COST PER ACRE, NOXIOUS WEED CONTROL, YEAR 3			\$32.43
	TOTAL COST PER ACRE, VEGETATION IMPROVEMENT (VI), YEAR 3			\$1,650.08
2006	Restoration enhancement planting:			
	Airlift planting supplies to installation sites	1	ls	\$34.83
	Plant seedlings - includes placement of amendments in planting hole and installation of tree protectors	1,000	seedling	\$745.32
	Implementation subtotal			\$780.15
	Containerized seedlings	1,000	seedling	\$287.50
	"Bio-Pak" (16-6-8 + minors) slow release fertilizer, 1	1,000	packet	\$15.00
	Pelletized compost - 1 pint/seedling	1,000	pint	\$12.95
	"Treepro Junior" - 4"x12" plant protector, 1	1,000	protector	\$115.00
	Materials subtotal			\$430.45
	Project Design and Work Plan - 3% of implementation costs	1	ls	\$23.40
	Monitoring - 1% of implementation costs	1	ls	\$7.80
	Project Management - 15% of implementation costs	1	ls	\$117.02
	Contractor's Margin - 10% of material costs	1	ls	\$47.83
	Contingency - 15% of total costs	1	ls	\$211.00
	Contractor Project Fees Subtotal			\$407.05
	TOTAL COST PER ACRE, RESTORATION ENHANCEMENT PLANTING, YEAR 4			\$1,617.66
2006	Replacement plant installation:			
	Airlift replanting supplies to installation sites - 20% of Year 3 airlift costs	1	ls	\$6.97
	Plant replacement seedlings - 20% of Year 3 planting costs	1	ls	\$149.06
	Implementation subtotal			\$156.03
	Replacement containerized seedlings - 20% of Year 3 totals	1	ls	\$57.50
	Replacement plant protectors and amendments	1	ls	\$28.59
	Materials subtotal			\$86.09
	Project Design and Work Plan - 3% of implementation costs	1	ls	\$4.68
	Monitoring - 1% of implementation costs	1	ls	\$1.56
	Project Management - 15% of implementation costs	1	ls	\$23.40
	Contractor's Margin - 10% of material costs	1	ls	\$9.57
	Contingency - 15% of total costs	1	ls	\$42.20
	Contractor Project Fees Subtotal			\$81.41
	TOTAL COST PER ACRE, REPLACEMENT PLANT INSTALLATION, YEAR 4			\$323.53
2006	Maintenance of plant protectors:			
	Maintenance of plant protectors - 10% of Year 3 planting costs	1	ls	\$74.53
	Implementation subtotal			\$74.53

Prescription: Vegetation Improvement (VI)				
	Project Design and Work Plan - 3% of implementation costs	1	ls	\$2.24
	Monitoring - 1% of implementation costs	1	ls	\$0.75
	Project Management - 15% of implementation costs	1	ls	\$11.18
	Contingency - 15% of total costs	1	ls	\$13.30
	Contractor Project Fees Subtotal			\$27.47
	TOTAL COST PER ACRE, MAINTENANCE OF PLANT PROTECTORS, YEAR 4			\$102.00
2006	Noxious weed control:			
	Release of beneficial insects for biological control of noxious weed species	1	ls	\$10.30
	Implementation subtotal			\$10.30
	Beneficial insects	27	carton	\$14.35
	Materials subtotal			\$14.35
	Project Design and Work Plan - 3% of implementation costs	1	ls	\$0.31
	Monitoring - 1% of implementation costs	1	ls	\$0.10
	Project Management - 15% of implementation costs	1	ls	\$1.55
	Contractor's Margin - 10% of material costs	1	ls	\$1.59
	Contingency - 15% of total costs	1	ls	\$4.23
	Contractor Project Fees Subtotal			\$7.78
	TOTAL COST PER ACRE, NOXIOUS WEED CONTROL, YEAR 4			\$32.43
	TOTAL COST PER ACRE, VEGETATION IMPROVEMENT (VI), YEAR 4			\$2,075.61
2007	Restoration enhancement planting:			
	Airlift planting supplies to installation sites	1	ls	\$34.83
	Plant seedlings - includes placement of amendments in planting hole and installation of tree protectors	1,000	seedling	\$745.32
	Implementation subtotal			\$780.15
	Containerized seedlings	1,000	seedling	\$287.50
	"Bio-Pak" (16-6-8 + minors) slow release fertilizer, 1 packet/seedling	1,000	packet	\$15.00
	Pelletized compost - 1 pint/seedling	1,000	pint	\$12.95
	"Treepro Junior" - 4"x12" plant protector, 1	1,000	protector	\$115.00
	Materials subtotal			\$430.45
	Project Design and Work Plan - 3% of implementation costs	1	ls	\$23.40
	Monitoring - 1% of implementation costs	1	ls	\$7.80
	Project Management - 15% of implementation costs	1	ls	\$117.02
	Contractor's Margin - 10% of material costs	1	ls	\$47.83
	Contingency - 15% of total costs	1	ls	\$211.00
	Contractor Project Fees Subtotal			\$407.05
	TOTAL COST PER ACRE, RESTORATION ENHANCEMENT PLANTING, YEAR 5			\$1,617.66
2007	Replacement plant installation:			
	Airlift replanting supplies to installation sites - 20% of Year 4 airlift costs	1	ls	\$6.97
	Plant replacement seedlings - 20% of Year 4 planting costs	1	ls	\$149.06
	Implementation subtotal			\$156.03
	Replacement containerized seedlings - 20% of Year 3 totals	1	ls	\$57.50
	Replacement plant protectors and amendments	1	ls	\$28.59
	Materials subtotal			\$86.09
	Project Design and Work Plan - 3% of implementation costs	1	ls	\$4.68
	Monitoring - 1% of implementation costs	1	ls	\$1.56
	Project Management - 15% of implementation costs	1	ls	\$23.40
	Contractor's Margin - 10% of material costs	1	ls	\$9.57

Prescription: Vegetation Improvement (VI)				
	Contingency - 15% of total costs	1	ls	\$42.20
	Contractor Project Fees Subtotal			\$81.41
	TOTAL COST PER ACRE, REPLACEMENT PLANT INSTALLATION, YEAR 5			\$323.53
2007	Maintenance of plant protectors:			
	Maintenance of plant protectors - 10% of Years 3 and 4 planting costs	1	ls	\$149.06
	Implementation subtotal			\$149.06
	Project Design and Work Plan - 3% of implementation costs	1	ls	\$4.47
	Monitoring - 1% of implementation costs	1	ls	\$1.49
	Project Management - 15% of implementation costs	1	ls	\$22.36
	Contingency - 15% of total costs	1	ls	\$26.61
	Contractor Project Fees Subtotal			\$54.93
	TOTAL COST PER ACRE, MAINTENANCE OF PLANT PROTECTORS, YEAR 5			\$203.99
2007	Noxious weed control:			
	Release of beneficial insects for biological control of noxious weed species	1	ls	\$10.30
	Implementation subtotal			\$10.30
	Beneficial insects	27	carton	\$14.35
	Materials subtotal			\$14.35
	Project Design and Work Plan - 3% of implementation costs	1	ls	\$0.31
	Monitoring - 1% of implementation costs	1	ls	\$0.10
	Project Management - 15% of implementation costs	1	ls	\$1.55
	Contractor's Margin - 10% of material costs	1	ls	\$1.59
	Contingency - 15% of total costs	1	ls	\$4.23
	Contractor Project Fees Subtotal			\$7.78
	TOTAL COST PER ACRE, NOXIOUS WEED CONTROL, YEAR 5			\$32.43
	TOTAL COST PER ACRE, VEGETATION IMPROVEMENT (VI), YEAR 5			\$2,177.61
2008	Restoration enhancement planting:			
	Airlift planting supplies to installation sites	1	ls	\$34.83
	Plant seedlings - includes placement of amendments in planting hole and installation of tree protectors	1,000	seedling	\$745.32
	Implementation subtotal			\$780.15
	Containerized seedlings	1,000	seedling	\$287.50
	"Bio-Pak" (16-6-8 + minors) slow release fertilizer, 1 packet/seedling	1,000	packet	\$15.00
	Pelletized compost - 1 pint/seedling	1,000	pint	\$12.95
	"Treepro Junior" - 4"x12" plant protector, 1	1,000	protector	\$115.00
	Materials subtotal			\$430.45
	Project Design and Work Plan - 3% of implementation costs	1	ls	\$23.40
	Monitoring - 1% of implementation costs	1	ls	\$7.80
	Project Management - 15% of implementation costs	1	ls	\$117.02
	Contractor's Margin - 10% of material costs	1	ls	\$47.83
	Contingency - 15% of total costs	1	ls	\$211.00
	Contractor Project Fees Subtotal			\$407.05
	TOTAL COST PER ACRE, RESTORATION ENHANCEMENT PLANTING, YEAR 6			\$1,617.66
2008	Replacement plant installation:			
	Airlift replanting supplies to installation sites - 20% of Year 5 airlift costs	1	ls	\$6.97

Prescription: Vegetation Improvement (VI)				
	Plant replacement seedlings - 20% of Year 5 planting costs	1	ls	\$149.06
	Implementation subtotal			\$156.03
	Replacement containerized seedlings - 20% of Year 3 totals	1	ls	\$57.50
	Replacement plant protectors and amendments	1	ls	\$28.59
	Materials subtotal			\$86.09
	Project Design and Work Plan - 3% of implementation costs	1	ls	\$4.68
	Monitoring - 1% of implementation costs	1	ls	\$1.56
	Project Management - 15% of implementation costs	1	ls	\$23.40
	Contractor's Margin - 10% of material costs	1	ls	\$9.57
	Contingency - 15% of total costs	1	ls	\$42.20
	Contractor Project Fees Subtotal			\$81.41
	TOTAL COST PER ACRE, REPLACEMENT PLANT INSTALLATION, YEAR 6			\$323.53
2008	Maintenance of plant protectors:			
	Maintenance of plant protectors - 10% of Years 4 and 5 planting costs	1	ls	\$149.06
	Implementation subtotal			\$149.06
	Project Design and Work Plan - 3% of implementation costs	1	ls	\$4.47
	Monitoring - 1% of implementation costs	1	ls	\$1.49
	Project Management - 15% of implementation costs	1	ls	\$22.36
	Contingency - 15% of total costs	1	ls	\$26.61
	Contractor Project Fees Subtotal			\$54.93
	TOTAL COST PER ACRE, MAINTENANCE OF PLANT PROTECTORS, YEAR 6			\$203.99
2008	Aerial application of fertilizer - maintenance rate:			
	Aerial fertilization - dry application, maintenance rate	1	ls	\$220.60
	Implementation subtotal			\$220.60
	"Biosol Mix" (7-2-3) - organic fertilizer, maintenance rate	0.5	ton	\$310.50
	Materials subtotal			\$310.50
	Project Design and Work Plan - 3% of implementation costs	1	ls	\$6.62
	Monitoring - 1.5% of implementation costs	1	ls	\$2.21
	Project Management - 15% of implementation costs	1	ls	\$33.09
	Contractor's Margin - 10% of material costs	1	ls	\$34.50
	Contingency - 15% of total costs	1	ls	\$91.13
	Contractor Project Fees Subtotal			\$167.54
	TOTAL COST PER ACRE, AERIAL APPLICATION OF FERTILIZER - MAINTENANCE RATE, YEAR 6			\$692.02
2008	Noxious weed control:			
	Release of beneficial insects for biological control of noxious weed species	1	ls	\$10.30
	Implementation subtotal			\$10.30
	Beneficial insects	27	carton	\$14.35
	Materials subtotal			\$14.35
	Project Design and Work Plan - 3% of implementation costs	1	ls	\$0.31
	Monitoring - 1% of implementation costs	1	ls	\$0.10
	Project Management - 15% of implementation costs	1	ls	\$1.55
	Contractor's Margin - 10% of material costs	1	ls	\$1.59
	Contingency - 15% of total costs	1	ls	\$4.23
	Contractor Project Fees Subtotal			\$7.78
	TOTAL COST PER ACRE, NOXIOUS WEED CONTROL, YEAR 6			\$32.43
	TOTAL COST PER ACRE, VEGETATION IMPROVEMENT (VI), YEAR 6			\$2,869.63

Prescription: Vegetation Improvement (VI)				
2009	Replacement plant installation:			
	Airlift replanting supplies to installation sites - 20% of Year 6 airlift costs	1	ls	\$6.97
	Plant replacement seedlings - 20% of Year 6 planting costs	1	ls	\$149.06
	Implementation subtotal			\$156.03
	Replacement containerized seedlings - 20% of Year 3 totals	1	ls	\$57.50
	Replacement plant protectors and amendments	1	ls	\$28.59
	Materials subtotal			\$86.09
	Project Design and Work Plan - 3% of implementation costs	1	ls	\$4.68
	Monitoring - 1% of implementation costs	1	ls	\$1.56
	Project Management - 15% of implementation costs	1	ls	\$23.40
	Contractor's Margin - 10% of material costs	1	ls	\$9.57
	Contingency - 15% of total costs	1	ls	\$42.20
	Contractor Project Fees Subtotal			\$81.41
	TOTAL COST PER ACRE, REPLACEMENT PLANT INSTALLATION, YEAR 7			\$323.53
2009	Maintenance of plant protectors:			
	Maintenance of plant protectors - 10% of Years 5 and 6 planting costs	1	ls	\$149.06
	Implementation subtotal			\$149.06
	Project Design and Work Plan - 3% of implementation costs	1	ls	\$4.47
	Monitoring - 1% of implementation costs	1	ls	\$1.49
	Project Management - 15% of implementation costs	1	ls	\$22.36
	Contingency - 15% of total costs	1	ls	\$26.61
	Contractor Project Fees Subtotal			\$54.93
	TOTAL COST PER ACRE, MAINTENANCE OF PLANT PROTECTORS, YEAR 7			\$203.99
2009	Noxious weed control:			
	Release of beneficial insects for biological control of noxious weed species	1	ls	\$10.30
	Implementation subtotal			\$10.30
	Beneficial insects	27	carton	\$14.35
	Materials subtotal			\$14.35
	Project Design and Work Plan - 3% of implementation costs	1	ls	\$0.31
	Monitoring - 1% of implementation costs	1	ls	\$0.10
	Project Management - 15% of implementation costs	1	ls	\$1.55
	Contractor's Margin - 10% of material costs	1	ls	\$1.59
	Contingency - 15% of total costs	1	ls	\$4.23
	Contractor Project Fees Subtotal			\$7.78
	TOTAL COST PER ACRE, NOXIOUS WEED CONTROL, YEAR 7			\$32.43
	TOTAL COST PER ACRE, VEGETATION IMPROVEMENT (VI), YEAR 7			\$559.95
2010	Maintenance of plant protectors:			
	Maintenance of plant protectors - 10% of Years 6 and 7 planting costs	1	ls	\$74.53
	Implementation subtotal			\$74.53
	Project Design and Work Plan - 3% of implementation costs	1	ls	\$2.24
	Monitoring - 1% of implementation costs	1	ls	\$0.75
	Project Management - 15% of implementation costs	1	ls	\$11.18
	Contingency - 15% of total costs	1	ls	\$13.30
	Contractor Project Fees Subtotal			\$27.47

Prescription: Vegetation Improvement (VI)	
TOTAL COST PER ACRE, MAINTENANCE OF PLANT PROTECTORS, YEAR 8	\$102.00
TOTAL COST PER ACRE, VEGETATION IMPROVEMENT (VI), YEAR 8	\$102.00
TOTAL COST PER ACRE, VEGETATION IMPROVEMENT (VI), INTENSIVE RESTORATION, ALL YEARS	\$10,779.90
TOTAL COST PER ACRE, VEGETATION IMPROVEMENT (VI), INTENSIVE RESTORATION, ALL YEARS - NET PRESENT VALUE	\$8,623.91

Prescription: Steep Slope Reclamation (SSR)				
Restoration Alternative: Intensive Restoration				
Treatment Summary: Aerial application of agricultural lime; aerial seeding; aerial application of fertilizers (initial rate); aerial application of hydromulch; aerial application of compost; restoration enhancement planting; install plant protectors; maintenance of plant protectors; replacement plant installation; noxious weed control; restoration monitoring				
Year	Treatment	Rate/acre	Unit	Cost/acre
2009	Aerial application of agricultural lime:			
	Aerial lime application	7.5	ton	\$3,500.00
	Ground support - for aerial lime application	1	ls	\$616.16
	Mobilization - for aerial lime application	1	ls	\$45.60
	Implementation subtotal			\$4,161.76
	Dolomitic lime	7.5	ton	\$540.00
	"Soilmaster WR" - Polymer Tackifier	70	gallon	\$420.00
	Materials subtotal			\$960.00
	Project Design and Work Plan - 3% of implementation costs	1	ls	\$124.85
	Project Management - 15% of implementation costs	1	ls	\$624.26
	Contractor's Margin - 10% of material costs	1	ls	\$106.67
	Contingency - 15% of total costs	1	ls	\$896.63
	Contractor Project Fees Subtotal			\$1,752.41
	TOTAL COST PER ACRE, AERIAL APPLICATION OF AGRICULTURAL LIME, YEAR 1			\$6,874.17
	TOTAL COST PER ACRE, STEEP SLOPE RECLAMATION (SSR), YEAR 1			\$6,874.17
2010	Aerial application of seed, fertilizer, and hydromulch:			
	Aerial seeding - dry application	1	ls	\$14.07
	Aerial slurry application of fertilizer, mulch, 3 tackifiers	1	ls	\$2,100.00
	Ground support - for aerial slurry application	1	ls	\$616.16
	Mobilization - for aerial slurry application	1	ls	\$198.94
	Implementation subtotal			\$2,929.17
	Native grass/forb seed mixture	4	pound	\$72.00
	Virgin wood fiber mulch	1	ton	\$320.00
	"Soilmaster WR" - Polymer Tackifier	70	gallon	\$420.00
	"Finnfibers" - Fibrous Tackifier	30	pound	\$75.00
	Guar Tackifier	50	pound	\$85.00
	"Biosol Mix" (7-2-3) - organic fertilizer, initial rate	1	ton	\$540.00
	Materials subtotal			\$1,512.00
	Project Design and Work Plan - 3% of implementation costs	1	ls	\$87.88
	Project Management - 15% of implementation costs	1	ls	\$439.38
	Contractor's Margin - 10% of material costs	1	ls	\$168.00
	Contingency - 15% of total costs	1	ls	\$770.46
	Contractor Project Fees Subtotal			\$1,465.71
	TOTAL COST PER ACRE, AERIAL APPLICATION OF SEED, FERTILIZER, AND HYDROMULCH, YEAR 2			\$5,906.88
	TOTAL COST PER ACRE, STEEP SLOPE RECLAMATION (SSR), YEAR 2			\$5,906.88
2011	Restoration enhancement planting:			
	Airlift planting supplies to installation sites	1	ls	\$34.83
	Plant seedlings - includes placement of amendments in planting hole and installation of tree protectors	1,000	ls	\$745.32
	Implementation subtotal			\$780.15
	Containerized seedlings	1,000	seedling	\$287.50
	"Bio-Pak" (16-6-8 + minors) slow release fertilizer, 1 packet/seedling	1,000	packet	\$15.00

Prescription: Steep Slope Reclamation (SSR)				
	Pelletized compost - 1 pint/seedling	1,000	pint	\$12.95
	"Treepro Junior" - 4"x12" plant protector, 1	1,000	protector	\$115.00
	Materials subtotal			\$430.45
	Project Design and Work Plan - 3% of implementation costs	1	ls	\$23.40
	Monitoring - 1% of implementation costs	1	ls	\$7.80
	Project Management - 15% of implementation costs	1	ls	\$117.02
	Contractor's Margin - 10% of material costs	1	ls	\$47.83
	Contingency - 15% of total costs	1	ls	\$211.00
	Contractor Project Fees Subtotal			\$407.05
	TOTAL COST PER ACRE, RESTORATION ENHANCEMENT PLANTING, YEAR 3			\$1,617.66
2011	Noxious weed control:			
	Release of beneficial insects for biological control of noxious weed species	1	ls	\$10.30
	Implementation subtotal			\$10.30
	Beneficial insects	27	carton	\$14.35
	Materials subtotal			\$14.35
	Project Design and Work Plan - 3% of implementation costs	1	ls	\$0.31
	Monitoring - 1% of implementation costs	1	ls	\$0.10
	Project Management - 15% of implementation costs	1	ls	\$1.55
	Contractor's Margin - 10% of material costs	1	ls	\$1.59
	Contingency - 15% of total costs	1	ls	\$4.23
	Contractor Project Fees Subtotal			\$7.78
	TOTAL COST PER ACRE, NOXIOUS WEED CONTROL, YEAR 3			\$32.43
2011	Aerial application of compost:			
	Aerial compost application	34	cubic yard (cy)	\$3,185.24
	Implementation subtotal			\$3,185.24
	Pelletized compost	34	cy	\$2,478.60
	Materials subtotal			\$2,478.60
	Project Design and Work Plan - 3% of implementation costs	1	ls	\$95.56
	Monitoring - 1% of implementation costs	1	ls	\$31.85
	Project Management - 15% of implementation costs	1	ls	\$477.79
	Contractor's Margin - 10% of material costs	1	ls	\$275.40
	Contingency - 15% of total costs	1	ls	\$503.88
	Contractor Project Fees Subtotal			\$1,384.48
	TOTAL COST PER ACRE, AERIAL APPLICATION OF COMPOST, YEAR 3			\$7,048.32
	TOTAL COST PER ACRE, STEEP SLOPE RECLAMATION (SSR), YEAR 3			\$8,698.40
2012	Restoration enhancement planting:			
	Airlift planting supplies to installation sites	1	ls	\$34.83
	Plant seedlings - includes placement of amendments in planting hole and installation of tree protectors	1,000	seedling	\$745.32
	Implementation subtotal			\$780.15
	Containerized seedlings	1,000	seedling	\$287.50
	"Bio-Pak" (16-6-8 + minors) slow release fertilizer, 1 packet/seedling	1,000	packet	\$15.00
	Pelletized compost - 1 pint/seedling	1,000	pint	\$12.95
	"Treepro Junior" - 4"x12" plant protector, 1	1,000	protector	\$115.00
	Materials subtotal			\$430.45
	Project Design and Work Plan - 3% of implementation costs	1	ls	\$23.40
	Monitoring - 1% of implementation costs	1	ls	\$7.80
	Project Management - 15% of implementation costs	1	ls	\$117.02

Prescription: Steep Slope Reclamation (SSR)				
	Contractor's Margin - 10% of material costs	1	ls	\$47.83
	Contingency - 15% of total costs	1	ls	\$211.00
	Contractor Project Fees Subtotal			\$407.05
	TOTAL COST PER ACRE, RESTORATION ENHANCEMENT PLANTING, YEAR 4			\$1,617.66
2012	Replacement plant installation:			
	Airlift replanting supplies to installation sites - 20% of Year 3 airlift costs	1	ls	\$6.97
	Plant replacement seedlings - 20% of Year 3 planting costs	1	ls	\$149.06
	Implementation subtotal			\$156.03
	Replacement containerized seedlings - 20% of Year 3 totals	1	ls	\$57.50
	Replacement plant protectors and amendments	1	ls	\$28.59
	Materials subtotal			\$86.09
	Project Design and Work Plan - 3% of implementation costs	1	ls	\$4.68
	Monitoring - 1% of implementation costs	1	ls	\$1.56
	Project Management - 15% of implementation costs	1	ls	\$23.40
	Contractor's Margin - 10% of material costs	1	ls	\$9.57
	Contingency - 15% of total costs	1	ls	\$42.20
	Contractor Project Fees Subtotal			\$81.41
	TOTAL COST PER ACRE, REPLACEMENT PLANT INSTALLATION, YEAR 4			\$323.53
2012	Maintenance of plant protectors:			
	Maintenance of plant protectors - 10% of Year 3 planting costs	1	ls	\$74.53
	Implementation subtotal			\$74.53
	Project Design and Work Plan - 3% of implementation costs	1	ls	\$2.24
	Monitoring - 1% of implementation costs	1	ls	\$0.75
	Project Management - 15% of implementation costs	1	ls	\$11.18
	Contingency - 15% of total costs	1	ls	\$13.30
	Contractor Project Fees Subtotal			\$27.47
	TOTAL COST PER ACRE, MAINTENANCE OF PLANT PROTECTORS, YEAR 4			\$102.00
2012	Noxious weed control:			
	Release of beneficial insects for biological control of noxious weed species	1	ls	\$10.30
	Implementation subtotal			\$10.30
	Beneficial insects	27	carton	\$14.35
	Materials subtotal			\$14.35
	Project Design and Work Plan - 3% of implementation costs	1	ls	\$0.31
	Monitoring - 1% of implementation costs	1	ls	\$0.10
	Project Management - 15% of implementation costs	1	ls	\$1.55
	Contractor's Margin - 10% of material costs	1	ls	\$1.59
	Contingency - 15% of total costs	1	ls	\$4.23
	Contractor Project Fees Subtotal			\$7.78
	TOTAL COST PER ACRE, NOXIOUS WEED CONTROL, YEAR 4			\$32.43
	TOTAL COST PER ACRE, STEEP SLOPE RECLAMATION (SSR), YEAR 4			\$2,075.61
2013	Restoration enhancement planting:			
	Airlift planting supplies to installation sites	1	ls	\$34.83
	Plant seedlings - includes placement of amendments in planting hole and installation of tree protectors	1	ls	\$745.32
	Implementation subtotal			\$780.15

Prescription: Steep Slope Reclamation (SSR)				
	Containerized seedlings	1	seedling	\$287.50
	"Bio-Pak" (16-6-8 + minors) slow release fertilizer, 1 packet/seedling	1	packet	\$15.00
	Pelletized compost - 1 pint/seedling	1	pint	\$12.95
	"Treepro Junior" - 4"x12" plant protector, 1	1	protector	\$115.00
	Materials subtotal			\$430.45
	Project Design and Work Plan - 3% of implementation costs	1	ls	\$23.40
	Monitoring - 1% of implementation costs	1	ls	\$7.80
	Project Management - 15% of implementation costs	1	ls	\$117.02
	Contractor's Margin - 10% of material costs	1	ls	\$47.83
	Contingency - 15% of total costs	1	ls	\$211.00
	Contractor Project Fees Subtotal			\$407.05
	TOTAL COST PER ACRE, RESTORATION ENHANCEMENT PLANTING, YEAR 5			\$1,617.66
2013	Replacement plant installation:			
	Airlift replanting supplies to installation sites - 20% of Year 4 airlift costs	1	ls	\$6.97
	Plant replacement seedlings - 20% of Year 4 planting costs	1	ls	\$149.06
	Implementation subtotal			\$156.03
	Replacement containerized seedlings - 20% of Year 3 totals	1	ls	\$57.50
	Replacement plant protectors and amendments	1	ls	\$28.59
	Materials subtotal			\$86.09
	Project Design and Work Plan - 3% of implementation costs	1	ls	\$4.68
	Monitoring - 1% of implementation costs	1	ls	\$1.56
	Project Management - 15% of implementation costs	1	ls	\$23.40
	Contractor's Margin - 10% of material costs	1	ls	\$9.57
	Contingency - 15% of total costs	1	ls	\$42.20
	Contractor Project Fees Subtotal			\$81.41
	TOTAL COST PER ACRE, REPLACEMENT PLANT INSTALLATION, YEAR 5			\$323.53
2013	Maintenance of plant protectors:			
	Maintenance of plant protectors - 10% of Years 3 and 4 planting costs	1	ls	\$149.06
	Implementation subtotal			\$149.06
	Project Design and Work Plan - 3% of implementation costs	1	ls	\$4.47
	Monitoring - 1% of implementation costs	1	ls	\$1.49
	Project Management - 15% of implementation costs	1	ls	\$22.36
	Contingency - 15% of total costs	1	ls	\$26.61
	Contractor Project Fees Subtotal			\$54.93
	TOTAL COST PER ACRE, MAINTENANCE OF PLANT PROTECTORS, YEAR 5			\$203.99
2013	Noxious weed control:			
	Release of beneficial insects for biological control of noxious weed species	1	ls	\$10.30
	Implementation subtotal			\$10.30
	Beneficial insects	27	carton	\$14.35
	Materials subtotal			\$14.35
	Project Design and Work Plan - 3% of implementation costs	1	ls	\$0.31
	Monitoring - 1% of implementation costs	1	ls	\$0.10
	Project Management - 15% of implementation costs	1	ls	\$1.55
	Contractor's Margin - 10% of material costs	1	ls	\$1.59
	Contingency - 15% of total costs	1	ls	\$4.23
	Contractor Project Fees Subtotal			\$7.78

Prescription: Steep Slope Reclamation (SSR)				
TOTAL COST PER ACRE, NOXIOUS WEED CONTROL, YEAR 5				\$32.43
TOTAL COST PER ACRE, STEEP SLOPE RECLAMATION (SSR), YEAR 5				\$2,177.61
2014	Restoration enhancement planting:			
	Airlift planting supplies to installation sites	1	ls	\$34.83
	Plant seedlings - includes placement of amendments in planting hole and installation of tree protectors	1	ls	\$745.32
	Implementation subtotal			\$780.15
	Containerized seedlings	1	seedling	\$287.50
	"Bio-Pak" (16-6-8 + minors) slow release fertilizer, 1 packet/seedling	1	packet	\$15.00
	Pelletized compost - 1 pint/seedling	1	pint	\$12.95
	"Treepro Junior" - 4"x12" plant protector, 1	1	protector	\$115.00
	Materials subtotal			\$430.45
	Project Design and Work Plan - 3% of implementation costs	1	ls	\$23.40
	Monitoring - 1% of implementation costs	1	ls	\$7.80
	Project Management - 15% of implementation costs	1	ls	\$117.02
	Contractor's Margin - 10% of material costs	1	ls	\$47.83
	Contingency - 15% of total costs	1	ls	\$211.00
	Contractor Project Fees Subtotal			\$407.05
TOTAL COST PER ACRE, RESTORATION ENHANCEMENT PLANTING, YEAR 6				\$1,617.66
2014	Replacement plant installation:			
	Airlift replanting supplies to installation sites - 20% of Year 5 airlift costs	1	ls	\$6.97
	Plant replacement seedlings - 20% of Year 5 planting costs	1	ls	\$149.06
	Implementation subtotal			\$156.03
	Replacement containerized seedlings - 20% of Year 3 totals	1	ls	\$57.50
	Replacement plant protectors and amendments	1	ls	\$28.59
	Materials subtotal			\$86.09
	Project Design and Work Plan - 3% of implementation costs	1	ls	\$4.68
	Monitoring - 1% of implementation costs	1	ls	\$1.56
	Project Management - 15% of implementation costs	1	ls	\$23.40
	Contractor's Margin - 10% of material costs	1	ls	\$9.57
	Contingency - 15% of total costs	1	ls	\$42.20
	Contractor Project Fees Subtotal			\$81.41
TOTAL COST PER ACRE, REPLACEMENT PLANT INSTALLATION, YEAR 6				\$323.53
2014	Maintenance of plant protectors:			
	Maintenance of plant protectors - 10% of Years 4 and 5 planting costs	1	ls	\$149.06
	Implementation subtotal			\$149.06
	Project Design and Work Plan - 3% of implementation costs	1	ls	\$4.47
	Monitoring - 1% of implementation costs	1	ls	\$1.49
	Project Management - 15% of implementation costs	1	ls	\$22.36
	Contingency - 15% of total costs	1	ls	\$26.61
	Contractor Project Fees Subtotal			\$54.93
TOTAL COST PER ACRE, MAINTENANCE OF PLANT PROTECTORS, YEAR 6				\$203.99
2014	Aerial application of fertilizer - maintenance rate:			
	Aerial fertilization - dry application, maintenance rate	1	ls	\$220.60
	Implementation subtotal			\$220.60
	"Biosol Mix" (7-2-3) - organic fertilizer, maintenance rate	0.5	ton	\$310.50

Prescription: Steep Slope Reclamation (SSR)				
	Materials subtotal			\$310.50
	Project Design and Work Plan - 3% of implementation costs	1	ls	\$6.62
	Monitoring - 1.5% of implementation costs	1	ls	\$2.21
	Project Management - 15% of implementation costs	1	ls	\$33.09
	Contractor's Margin - 10% of material costs	1	ls	\$34.50
	Contingency - 15% of total costs	1	ls	\$91.13
	Contractor Project Fees Subtotal			\$167.54
	TOTAL COST PER ACRE, AERIAL APPLICATION OF FERTILIZER - MAINTENANCE RATE, YEAR 6			\$692.02
2014	Noxious weed control:			
	Release of beneficial insects for biological control of noxious weed species	1	ls	\$10.30
	Implementation subtotal			\$10.30
	Beneficial insects	27	carton	\$14.35
	Materials subtotal			\$14.35
	Project Design and Work Plan - 3% of implementation costs	1	ls	\$0.31
	Monitoring - 1% of implementation costs	1	ls	\$0.10
	Project Management - 15% of implementation costs	1	ls	\$1.55
	Contractor's Margin - 10% of material costs	1	ls	\$1.59
	Contingency - 15% of total costs	1	ls	\$4.23
	Contractor Project Fees Subtotal			\$7.78
	TOTAL COST PER ACRE, NOXIOUS WEED CONTROL, YEAR 6			\$32.43
	TOTAL COST PER ACRE, STEEP SLOPE RECLAMATION (SSR), YEAR 6			\$2,869.63
2015	Replacement plant installation:			
	Airlift replanting supplies to installation sites - 20% of Year 6 airlift costs	1	ls	\$6.97
	Plant replacement seedlings - 20% of Year 6 planting costs	1	ls	\$149.06
	Implementation subtotal			\$156.03
	Replacement containerized seedlings - 20% of Year 3 totals	1	ls	\$57.50
	Replacement plant protectors and amendments	1	ls	\$28.59
	Materials subtotal			\$86.09
	Project Design and Work Plan - 3% of implementation costs	1	ls	\$4.68
	Monitoring - 1% of implementation costs	1	ls	\$1.56
	Project Management - 15% of implementation costs	1	ls	\$23.40
	Contractor's Margin - 10% of material costs	1	ls	\$9.57
	Contingency - 15% of total costs	1	ls	\$42.20
	Contractor Project Fees Subtotal			\$81.41
	TOTAL COST PER ACRE, REPLACEMENT PLANT INSTALLATION, YEAR 7			\$323.53
2015	Maintenance of plant protectors:			
	Maintenance of plant protectors - 10% of Years 5 and 6 planting costs	1	ls	\$149.06
	Implementation subtotal			\$149.06
	Project Design and Work Plan - 3% of implementation costs	1	ls	\$4.47
	Monitoring - 1% of implementation costs	1	ls	\$1.49
	Project Management - 15% of implementation costs	1	ls	\$22.36
	Contingency - 15% of total costs	1	ls	\$26.61
	Contractor Project Fees Subtotal			\$54.93
	TOTAL COST PER ACRE, MAINTENANCE OF PLANT PROTECTORS, YEAR 7			\$203.99

Prescription: Steep Slope Reclamation (SSR)

2015	Noxious weed control:			
	Release of beneficial insects for biological control of noxious weed species	1	ls	\$10.30
	Implementation subtotal			\$10.30
	Beneficial insects	27	carton	\$14.35
	Materials subtotal			\$14.35
	Project Design and Work Plan - 3% of implementation costs	1	ls	\$0.31
	Monitoring - 1% of implementation costs	1	ls	\$0.10
	Project Management - 15% of implementation costs	1	ls	\$1.55
	Contractor's Margin - 10% of material costs	1	ls	\$1.59
	Contingency - 15% of total costs	1	ls	\$4.23
	Contractor Project Fees Subtotal			\$7.78
	TOTAL COST PER ACRE, NOXIOUS WEED CONTROL, YEAR 7			\$32.43
	TOTAL COST PER ACRE, STEEP SLOPE RECLAMATION (SSR), YEAR 7			\$559.95
2016	Maintenance of plant protectors:			
	Maintenance of plant protectors - 10% of Years 6 and 7 planting costs	1	ls	\$74.53
	Implementation subtotal			\$74.53
	Project Design and Work Plan - 3% of implementation costs	1	ls	\$2.24
	Monitoring - 1% of implementation costs	1	ls	\$0.75
	Project Management - 15% of implementation costs	1	ls	\$11.18
	Contingency - 15% of total costs	1	ls	\$13.30
	Contractor Project Fees Subtotal			\$27.47
	TOTAL COST PER ACRE, MAINTENANCE OF PLANT PROTECTORS, YEAR 8			\$102.00
	TOTAL COST PER ACRE, STEEP SLOPE RECLAMATION (SSR), YEAR 8			\$102.00
	TOTAL COST PER ACRE, STEEP SLOPE RECLAMATION (SSR), ACTIVE RESTORATION, ALL YEARS			\$29,264.26
	TOTAL COST PER ACRE, STEEP SLOPE RECLAMATION (SSR), ACTIVE RESTORATION, ALL YEARS - NET PRESENT VALUE			\$20,121.07

Prescription: Well Vegetated (WV)				
Restoration Alternative: Intensive Restoration				
Treatment Summary: Restoration enhancement planting; install plant protectors; maintenance of plant protectors; replacement plant installation; noxious weed control; restoration monitoring				
Year	Treatment	Rate/acre	Unit	Cost/acre
2003	TOTAL COST PER ACRE, WELL VEGETATED (WV), YEAR 1			\$0.00
2004	TOTAL COST PER ACRE, WELL VEGETATED (WV), YEAR 2			\$0.00
2005	Restoration enhancement planting:			
	Airlift planting supplies to installation sites	1	ls	\$34.83
	Plant seedlings - includes placement of amendments in planting hole and installation of tree protectors	1,000	seedling	\$745.32
	Implementation subtotal			\$780.15
	Containerized seedlings	1,000	seedling	\$287.50
	"Bio-Pak" (16-6-8 + minors) slow release fertilizer, 1 packet/seedling	1,000	packet	\$15.00
	Pelletized compost - 1 pint/seedling	1,000	pint	\$12.95
	"Treepro Junior" - 4"x12" plant protector, 1	1,000	protector	\$115.00
	Materials subtotal			\$430.45
	Project Design and Work Plan - 3% of implementation costs	1	ls	\$23.40
	Monitoring - 1% of implementation costs	1	ls	\$7.80
	Project Management - 15% of implementation costs	1	ls	\$117.02
	Contractor's Margin - 10% of material costs	1	ls	\$47.83
	Contingency - 15% of total costs	1	ls	\$211.00
	Contractor Project Fees Subtotal			\$407.05
	TOTAL COST PER ACRE, RESTORATION ENHANCEMENT PLANTING, YEAR 3			\$1,617.66
2005	Noxious weed control:			
	Release of beneficial insects for biological control of noxious weed species	1	ls	\$10.30
	Implementation subtotal			\$10.30
	Beneficial insects	27	carton	\$14.35
	Materials subtotal			\$14.35
	Project Design and Work Plan - 3% of implementation costs	1	ls	\$0.31
	Monitoring - 1% of implementation costs	1	ls	\$0.10
	Project Management - 15% of implementation costs	1	ls	\$1.55
	Contractor's Margin - 10% of material costs	1	ls	\$1.59
	Contingency - 15% of total costs	1	ls	\$4.23
	Contractor Project Fees Subtotal			\$7.78
	TOTAL COST PER ACRE, NOXIOUS WEED CONTROL, YEAR 3			\$32.43
	TOTAL COST PER ACRE, WELL VEGETATED (WV), YEAR 3			\$1,650.08
2006	Restoration enhancement planting:			
	Airlift planting supplies to installation sites	1	ls	\$34.83
	Plant seedlings - includes placement of amendments in planting hole and installation of tree protectors	1,000	seedling	\$745.32
	Implementation subtotal			\$780.15
	Containerized seedlings	1,000	seedling	\$287.50
	"Bio-Pak" (16-6-8 + minors) slow release fertilizer, 1 packet/seedling	1,000	packet	\$15.00
	Pelletized compost - 1 pint/seedling	1,000	pint	\$12.95
	"Treepro Junior" - 4"x12" plant protector, 1	1,000	protector	\$115.00
	Materials subtotal			\$430.45

Prescription: Well Vegetated (WV)				
	Project Design and Work Plan - 3% of implementation costs	1	ls	\$23.40
	Monitoring - 1% of implementation costs	1	ls	\$7.80
	Project Management - 15% of implementation costs	1	ls	\$117.02
	Contractor's Margin - 10% of material costs	1	ls	\$47.83
	Contingency - 15% of total costs	1	ls	\$211.00
	Contractor Project Fees Subtotal			\$407.05
	TOTAL COST PER ACRE, RESTORATION ENHANCEMENT PLANTING, YEAR 4			\$1,617.66
2006	Replacement plant installation:			
	Airlift replanting supplies to installation sites - 20% of Year 3 airlift costs	1	ls	\$6.97
	Plant replacement seedlings - 20% of Year 3 planting costs	1	ls	\$149.06
	Implementation subtotal			\$156.03
	Replacement containerized seedlings - 20% of Year 3 totals	1	ls	\$57.50
	Replacement plant protectors and amendments	1	ls	\$28.59
	Materials subtotal			\$86.09
	Project Design and Work Plan - 3% of implementation costs	1	ls	\$4.68
	Monitoring - 1% of implementation costs	1	ls	\$1.56
	Project Management - 15% of implementation costs	1	ls	\$23.40
	Contractor's Margin - 10% of material costs	1	ls	\$9.57
	Contingency - 15% of total costs	1	ls	\$42.20
	Contractor Project Fees Subtotal			\$81.41
	TOTAL COST PER ACRE, REPLACEMENT PLANT INSTALLATION, YEAR 4			\$323.53
2006	Maintenance of plant protectors:			
	Maintenance of plant protectors - 10% of Year 3 planting costs	1	ls	\$74.53
	Implementation subtotal			\$74.53
	Project Design and Work Plan - 3% of implementation costs	1	ls	\$2.24
	Monitoring - 1% of implementation costs	1	ls	\$0.75
	Project Management - 15% of implementation costs	1	ls	\$11.18
	Contingency - 15% of total costs	1	ls	\$13.30
	Contractor Project Fees Subtotal			\$27.47
	TOTAL COST PER ACRE, MAINTENANCE OF PLANT PROTECTORS, YEAR 4			\$102.00
2006	Noxious weed control:			
	Release of beneficial insects for biological control of noxious weed species	1	ls	\$10.30
	Implementation subtotal			\$10.30
	Beneficial insects	27	carton	\$14.35
	Materials subtotal			\$14.35
	Project Design and Work Plan - 3% of implementation costs	1	ls	\$0.31
	Monitoring - 1% of implementation costs	1	ls	\$0.10
	Project Management - 15% of implementation costs	1	ls	\$1.55
	Contractor's Margin - 10% of material costs	1	ls	\$1.59
	Contingency - 15% of total costs	1	ls	\$4.23
	Contractor Project Fees Subtotal			\$7.78
	TOTAL COST PER ACRE, NOXIOUS WEED CONTROL, YEAR 4			\$32.43
	TOTAL COST PER ACRE, WELL VEGETATED (WV), YEAR 4			\$2,075.61
2007	Restoration enhancement planting:			
	Airlift planting supplies to installation sites	1	ls	\$34.83

Prescription: Well Vegetated (WV)				
	Plant seedlings - includes placement of amendments in planting hole and installation of tree protectors	1,000	seedling	\$745.32
	Implementation subtotal			\$780.15
	Containerized seedlings	1,000	seedling	\$287.50
	"Bio-Pak" (16-6-8 + minors) slow release fertilizer, 1 packet/seedling	1,000	packet	\$15.00
	Pelletized compost - 1 pint/seedling	1,000	pint	\$12.95
	"Treepro Junior" - 4"x12" plant protector, 1	1,000	protector	\$115.00
	Materials subtotal			\$430.45
	Project Design and Work Plan - 3% of implementation costs	1	ls	\$23.40
	Monitoring - 1% of implementation costs	1	ls	\$7.80
	Project Management - 15% of implementation costs	1	ls	\$117.02
	Contractor's Margin - 10% of material costs	1	ls	\$47.83
	Contingency - 15% of total costs	1	ls	\$211.00
	Contractor Project Fees Subtotal			\$407.05
	TOTAL COST PER ACRE, RESTORATION ENHANCEMENT PLANTING, YEAR 5			\$1,617.66
2007	Replacement plant installation:			
	Airlift replanting supplies to installation sites - 20% of Year 4 airlift costs	1	ls	\$6.97
	Plant replacement seedlings - 20% of Year 4 planting costs	1	ls	\$149.06
	Implementation subtotal			\$156.03
	Replacement containerized seedlings - 20% of Year 3 totals	1	ls	\$57.50
	Replacement plant protectors and amendments	1	ls	\$28.59
	Materials subtotal			\$86.09
	Project Design and Work Plan - 3% of implementation costs	1	ls	\$4.68
	Monitoring - 1% of implementation costs	1	ls	\$1.56
	Project Management - 15% of implementation costs	1	ls	\$23.40
	Contractor's Margin - 10% of material costs	1	ls	\$9.57
	Contingency - 15% of total costs	1	ls	\$42.20
	Contractor Project Fees Subtotal			\$81.41
	TOTAL COST PER ACRE, REPLACEMENT PLANT INSTALLATION, YEAR 5			\$323.53
2007	Maintenance of plant protectors:			
	Maintenance of plant protectors - 10% of Years 3 and 4 planting costs	1	ls	\$149.06
	Implementation subtotal			\$149.06
	Project Design and Work Plan - 3% of implementation costs	1	ls	\$4.47
	Monitoring - 1% of implementation costs	1	ls	\$1.49
	Project Management - 15% of implementation costs	1	ls	\$22.36
	Contingency - 15% of total costs	1	ls	\$26.61
	Contractor Project Fees Subtotal			\$54.93
	TOTAL COST PER ACRE, MAINTENANCE OF PLANT PROTECTORS, YEAR 5			\$203.99
2007	Noxious weed control:			
	Release of beneficial insects for biological control of noxious weed species	1	ls	\$10.30
	Implementation subtotal			\$10.30
	Beneficial insects	27	carton	\$14.35
	Materials subtotal			\$14.35
	Project Design and Work Plan - 3% of implementation costs	1	ls	\$0.31
	Monitoring - 1% of implementation costs	1	ls	\$0.10
	Project Management - 15% of implementation costs	1	ls	\$1.55
	Contractor's Margin - 10% of material costs	1	ls	\$1.59

Prescription: Well Vegetated (WV)				
	Contingency - 15% of total costs	1	Is	\$4.23
	Contractor Project Fees Subtotal			\$7.78
	TOTAL COST PER ACRE, NOXIOUS WEED CONTROL, YEAR 5			\$32.43
	TOTAL COST PER ACRE, WELL VEGETATED (WV), YEAR 5			\$2,177.61
2008	Restoration enhancement planting:			
	Airlift planting supplies to installation sites	1	Is	\$34.83
	Plant seedlings - includes placement of amendments in planting hole and installation of tree protectors	1,000	seedling	\$745.32
	Implementation subtotal			\$780.15
	Containerized seedlings	1,000	seedling	\$287.50
	"Bio-Pak" (16-6-8 + minors) slow release fertilizer, 1 packet/seedling	1,000	packet	\$15.00
	Pelletized compost - 1 pint/seedling	1,000	pint	\$12.95
	"Treepro Junior" - 4"x12" plant protector, 1	1,000	protector	\$115.00
	Materials subtotal			\$430.45
	Project Design and Work Plan - 3% of implementation costs	1	Is	\$23.40
	Monitoring - 1% of implementation costs	1	Is	\$7.80
	Project Management - 15% of implementation costs	1	Is	\$117.02
	Contractor's Margin - 10% of material costs	1	Is	\$47.83
	Contingency - 15% of total costs	1	Is	\$211.00
	Contractor Project Fees Subtotal			\$407.05
	TOTAL COST PER ACRE, RESTORATION ENHANCEMENT PLANTING, YEAR 6			\$1,617.66
2008	Replacement plant installation:			
	Airlift replanting supplies to installation sites - 20% of Year 5 airlift costs	1	Is	\$6.97
	Plant replacement seedlings - 20% of Year 5 planting costs	1	Is	\$149.06
	Implementation subtotal			\$156.03
	Replacement containerized seedlings - 20% of Year 3 totals	1	Is	\$57.50
	Replacement plant protectors and amendments	1	Is	\$28.59
	Materials subtotal			\$86.09
	Project Design and Work Plan - 3% of implementation costs	1	Is	\$4.68
	Monitoring - 1% of implementation costs	1	Is	\$1.56
	Project Management - 15% of implementation costs	1	Is	\$23.40
	Contractor's Margin - 10% of material costs	1	Is	\$9.57
	Contingency - 15% of total costs	1	Is	\$42.20
	Contractor Project Fees Subtotal			\$81.41
	TOTAL COST PER ACRE, REPLACEMENT PLANT INSTALLATION, YEAR 6			\$323.53
2008	Maintenance of plant protectors:			
	Maintenance of plant protectors - 10% of Years 4 and 5 planting costs	1	Is	\$149.06
	Implementation subtotal			\$149.06
	Project Design and Work Plan - 3% of implementation costs	1	Is	\$4.47
	Monitoring - 1% of implementation costs	1	Is	\$1.49
	Project Management - 15% of implementation costs	1	Is	\$22.36
	Contingency - 15% of total costs	1	Is	\$26.61
	Contractor Project Fees Subtotal			\$54.93
	TOTAL COST PER ACRE, MAINTENANCE OF PLANT PROTECTORS, YEAR 6			\$203.99
2008	Noxious weed control:			

Prescription: Well Vegetated (WV)				
	Release of beneficial insects for biological control of noxious	1	ls	\$10.30
	Implementation subtotal			\$10.30
	Beneficial insects	27	carton	\$14.35
	Materials subtotal			\$14.35
	Project Design and Work Plan - 3% of implementation costs	1	ls	\$0.31
	Monitoring - 1% of implementation costs	1	ls	\$0.10
	Project Management - 15% of implementation costs	1	ls	\$1.55
	Contractor's Margin - 10% of material costs	1	ls	\$1.59
	Contingency - 15% of total costs	1	ls	\$4.23
	Contractor Project Fees Subtotal			\$7.78
	TOTAL COST PER ACRE, NOXIOUS WEED CONTROL, YEAR 6			\$32.43
	TOTAL COST PER ACRE, WELL VEGETATED (WV), YEAR 6			\$2,177.61
2009	Replacement plant installation:			
	Airlift replanting supplies to installation sites - 20% of Year 6 airlift costs	1	ls	\$6.97
	Plant replacement seedlings - 20% of Year 6 planting costs	1	ls	\$149.06
	Implementation subtotal			\$156.03
	Replacement containerized seedlings - 20% of Year 3 totals	1	ls	\$57.50
	Replacement plant protectors and amendments	1	ls	\$28.59
	Materials subtotal			\$86.09
	Project Design and Work Plan - 3% of implementation costs	1	ls	\$4.68
	Monitoring - 1% of implementation costs	1	ls	\$1.56
	Project Management - 15% of implementation costs	1	ls	\$23.40
	Contractor's Margin - 10% of material costs	1	ls	\$9.57
	Contingency - 15% of total costs	1	ls	\$42.20
	Contractor Project Fees Subtotal			\$81.41
	TOTAL COST PER ACRE, REPLACEMENT PLANT INSTALLATION, YEAR 7			\$323.53
2009	Maintenance of plant protectors:			
	Maintenance of plant protectors - 10% of Years 5 and 6 planting costs	1	ls	\$149.06
	Implementation subtotal			\$149.06
	Project Design and Work Plan - 3% of implementation costs	1	ls	\$4.47
	Monitoring - 1% of implementation costs	1	ls	\$1.49
	Project Management - 15% of implementation costs	1	ls	\$22.36
	Contingency - 15% of total costs	1	ls	\$26.61
	Contractor Project Fees Subtotal			\$54.93
	TOTAL COST PER ACRE, MAINTENANCE OF PLANT PROTECTORS, YEAR 7			\$203.99
2009	Noxious weed control:			
	Release of beneficial insects for biological control of noxious weed species	1	ls	\$10.30
	Implementation subtotal			\$10.30
	Beneficial insects	27	carton	\$14.35
	Materials subtotal			\$14.35
	Project Design and Work Plan - 3% of implementation costs	1	ls	\$0.31
	Monitoring - 1% of implementation costs	1	ls	\$0.10
	Project Management - 15% of implementation costs	1	ls	\$1.55
	Contractor's Margin - 10% of material costs	1	ls	\$1.59
	Contingency - 15% of total costs	1	ls	\$4.23
	Contractor Project Fees Subtotal			\$7.78

Prescription: Well Vegetated (WV)				
TOTAL COST PER ACRE, NOXIOUS WEED CONTROL, YEAR 7				\$32.43
TOTAL COST PER ACRE, WELL VEGETATED (WV), YEAR 7				\$559.95
2010	Maintenance of plant protectors:			
	Maintenance of plant protectors - 10% of Years 6 and 7 planting costs	1	ls	\$74.53
	Implementation subtotal			\$74.53
	Project Design and Work Plan - 3% of implementation costs	1	ls	\$2.24
	Monitoring - 1% of implementation costs	1	ls	\$0.75
	Project Management - 15% of implementation costs	1	ls	\$11.18
	Contingency - 15% of total costs	1	ls	\$13.30
	Contractor Project Fees Subtotal			\$27.47
TOTAL COST PER ACRE, MAINTENANCE OF PLANT PROTECTORS, YEAR 8				\$102.00
TOTAL COST PER ACRE, WELL VEGETATED (WV), YEAR 8				\$102.00
TOTAL COST PER ACRE, WELL VEGETATED (WV), INTENSIVE RESTORATION, ALL YEARS				\$8,742.87
TOTAL COST PER ACRE, WELL VEGETATED (WV), INTENSIVE RESTORATION, ALL YEARS - NET PRESENT VALUE				\$6,926.28

APPENDIX A

COMMON AND LATIN NAMES OF PLANT SPECIES

Appendix A: Common and Latin Names of Plant Species

Common Name	Latin Name
Alfalfa	<i>Medicago sativa</i>
Antelope Bitterbrush	<i>Purshia tridentata</i>
Antennaria	<i>Antennaria racemosa</i>
Arnica	<i>Arnica sp.</i>
Arrowleaf Balsamroot	<i>Balsamorhiza sagittata</i>
Aster	<i>Aster conspicuus</i>
Basin Wildrye	<i>Elymus cinereus</i>
Bearberry	<i>Arctostaphylos uva-ursi</i>
Beargrass	<i>Xerophyllum tenax</i>
Bebb's Willow	<i>Salix bebbiana</i>
Bent Grass	<i>Agrostis spp</i>
Bessey, Wyoming Kittenails	<i>Bessey, wyomingensis</i>
Big sagebrush	<i>Artemisia tridentata</i>
Biscuitroot	<i>Lomatium triternatum</i>
Black Cottonwood	<i>Populus trichocarpa</i>
Black Twinberry	<i>Lonicera involucrata</i>
Blue Flax	<i>Linum lewisii</i>
Bluebunch Wheatgrass	<i>Agropyron spicatum</i>
Bluegrass	<i>Poa spp.</i>
Bottlebrush Squirreltail	<i>Sitanion hystrix</i>
Canada Thistle	<i>Cirsium arvense</i>
Carex	<i>Carex spp.</i>
Chrysopsis	<i>Chrysopsis villosa</i>
Common Chokecherry	<i>Prunus virginiana</i>
Common Juniper	<i>Juniperus communis</i>
Cranesbill	<i>Geranium viscosissimum</i>
Creeping Juniper	<i>Juniperus horizontalis</i>
Current, Gooseberry	<i>Ribes spp.</i>
Douglas-Fir	<i>Pseudotsuga menziesii</i>
Downy Brome	<i>Bromus tectorum</i>
Dwarf Huckleberry	<i>Vaccinium caespitosum</i>
Elk Sedge	<i>Carex geyeri</i>
Engelmann Spruce	<i>Picea engelmannii</i>
False Solomon's Seal	<i>Smilacina racemosa</i>
Field Chickweed	<i>Cerastium arvense</i>
Fireweed	<i>Epilobium angustifolium</i>
Globe Huckleberry	<i>Vaccinium globulare</i>
Goatsbeard	<i>Tragopogon dubius</i>
Gooseberry	<i>Ribes spp.</i>
Graceful Cinquefoil	<i>Potentilla gracilis</i>
Grand Fir	<i>Abies grandis</i>
Green Rabbitbrush	<i>Chrysothamnus viscidiflorus</i>
Grouse Whortleberry	<i>Vaccinium scoparium</i>
Hairy Golden Aster	<i>Chrysopsis villosa</i>

Hairy Vetch	<i>Vicia villosa</i>
Harebell	<i>Campanula rotundifolia</i>
Heartleaf Arnica	<i>Arnica cordifolia</i>
Hood's Phlox	<i>Phlox hoodii</i>
Horizontal Juniper	<i>Juniperus horizontalis</i>
Horsebrush	<i>Tetradymia canescens</i>
Idaho Fescue	<i>Festuca idahoensis</i>
Indian Paint Brush	<i>Castilleja lutescens</i>
Japanese Brome	<i>Bromus japonicus</i>
Juncus	<i>Juncus spp.</i>
Lacy Phacelia	<i>Phacelia tanacetifolia</i>
Leafy Spurge	<i>Euphorbia esula</i>
Limber Pine	<i>Pinus flexilis</i>
Lodgepole Pine	<i>Pinus contorta</i>
Lupine	<i>Lupinus argenteus</i>
Mallow Ninebark	<i>Physocarpus malvaceus</i>
Menziesia	<i>Menziesia ferruginea</i>
Mountain Arnica	<i>Arnica latifolia</i>
Mountain Hemlock	<i>Tsuga mertensiana</i>
Mountain Strawberry	<i>Fragaria virginiana</i>
Mountain Sweet-cicely	<i>Osmorhiza chilensis</i>
Needle & Thread	<i>Stipa comata</i>
Nine-leaf Lomatium	<i>Lomatium triternatum</i>
Northern Bedstraw	<i>Galium boreale</i>
Northwest Cinquefoil	<i>Potentilla gracilis</i>
Old Man's Whiskers	<i>Geum triflorum</i>
Oregon Grape	<i>Berberis repens</i>
Pinegrass	<i>Calamagrostis rubescens</i>
Poa	<i>Poa spp.</i>
Ponderosa Pine	<i>Pinus ponderosa</i>
Prairie Junegrass	<i>Koeleria cristata</i>
Prairie Sage	<i>Artemisia ludoviciana</i>
Prairiesmoke	<i>Geum triflorum</i>
Pyrola	<i>Pyrola secunda</i>
Quaking Aspen	<i>Populus tremuloides</i>
Raceme Pussy-toes	<i>Antennaria racemosa</i>
Rocky Mountain Juniper	<i>Juniperus scopulorum</i>
Rocky Mountain Maple	<i>Acer glabrum</i>
Rocky Mountain Penstemon	<i>Penstemon strictus</i>
Rosy Pussy-toes	<i>Antennaria rosea</i>
Rough Fescue	<i>Festuca scabrella</i>
Round-leaved Violet	<i>Viola orbiculata</i>
Rubber Rabbitbrush	<i>Chrysothamnus nauseosus</i>
Rush	<i>Juncus spp.</i>
Russet Buffaloberry	<i>Shepherdia canadensis</i>
Sandberg Bluegrass	<i>Poa sandbergii (Poa secunda)</i>
Scouler's Willow	<i>Salix scouleriana</i>
Sedge	<i>Carex spp.</i>

Serviceberry	<i>Amelanchier alnifolia</i>
Sheep Fescue	<i>Festuca ovina</i>
Showy Aster	<i>Aster conspicuus</i>
Silky Lupine	<i>Lupinus sericeus</i>
Silvery Lupine	<i>Lupinus argenteus</i>
Sitka Alder	<i>Alnus sinuata</i>
Smooth Woodrush	<i>Luzula hitchcockii</i>
Snowberry	<i>Symphoricarpos albus</i>
Spotted Knapweed	<i>Centaurea maculosa</i>
Stoneseed	<i>Lithospermum ruderales</i>
Subalpine Fir	<i>Abies lasiocarpa</i>
Tall Kittentails	<i>Besseyia wyomingensis</i>
Tufted Hairgrass	<i>Deschampsia cespitosa</i>
Twinflower	<i>Linnaea borealis</i>
Western Hemlock	<i>Tsuga heterophylla</i>
Western Larch	<i>Larix occidentalis</i>
Western Meadowrue	<i>Thalictrum occidentale</i>
Western Needlegrass	<i>Stipa occidentalis</i>
Western Red Cedar	<i>Thuja plicata</i>
Western Salsify	<i>Tragopogon dubious</i>
White Fir	<i>Abies concolor</i>
White Spirea	<i>Spirea betulifolia</i>
Winterfat	<i>Ceratoides lanata</i>
Wintergreen, Shinleaf	<i>Pyrola secunda</i>
Woods Rose	<i>Rosa woodsii</i>
Yarrow, Milfoil	<i>Achillea millefolium</i>

APPENDIX B

CHARACTERISTIC BIRDS AND MAMMALS OF SOUTHWESTERN MONTANA

Appendix B: Characteristic Birds and Mammals of Southwestern Montana

Source: (Montana 1995)

Bird Species	
Red-tailed hawk	<i>Buteo jamaicensis</i>
Sharp-shinned hawk	<i>Accipiter striatus</i>
Cooper's hawk	<i>Accipiter cooperii</i>
Northern goshawk	<i>Accipiter gentilis</i>
Blue grouse	<i>Dendragapus obscurus</i>
Spruce grouse	<i>Dendragapus canadensis</i>
Northern saw-whet owl	<i>Aegolius acadicus</i>
Downy woodpecker	<i>Picoides pubescens</i>
Hairy woodpecker	<i>Picoides villosus</i>
Olive-sided flycatcher	<i>Contopus borealis</i>
Western wood-pewee	<i>Contopus sordidulus</i>
Grey jay	<i>Perisoreus canadensis</i>
Steller's jay	<i>Cyanocitta stelleri</i>
Clark's nutcracker	<i>Nucifraga columbiana</i>
Mountain chickadee	<i>Parus gambeli</i>
Red-breasted nuthatch	<i>Sitta canadensis</i>
House wren	<i>Troglodytes aedon</i>
Ruby-crowned kinglet	<i>Regulus calendula</i>
Mountain bluebird	<i>Sialia currucoides</i>
Townsend's solitaire	<i>Myadestes townsedii</i>
Swainson's thrush	<i>Catharus guttatus</i>
American robin	<i>Turdus migratorius</i>
Cedar waxwing	<i>Bombycilla cedrorum</i>
Yellow-rumped warbler	<i>Dendroica coronata</i>
Western tanager	<i>Piranga ludoviciana</i>
Chipping sparrow	<i>Spizella passerina</i>
White-crowned sparrow	<i>Zonotrichia leucophrys</i>
Dark-eyed junco	<i>Junco hyemalis</i>
Pine grosbeak	<i>Pinicola enucleator</i>
Red crossbill	<i>Loxia curvirostra</i>
Pine siskin	<i>Carduelis pinus</i>
Evening gosbeak	<i>Coccothraustes vespertinus</i>

Mammal Species	
Snowshoe hare	<i>Lepus americanus</i>
Red squirrel	<i>Tamiasciurus hudsonicus</i>
Porcupine	<i>Erethizon dorsatum</i>
Black bear	<i>Ursus americanus</i>
Pine marten	<i>Martes americana</i>
Ermine	<i>Mustella erminea</i>
Mountain lion	<i>Felis concolor</i>
Bobcat	<i>Felis rufus</i>
Lynx	<i>Felis lynx</i>
Elk	<i>Cervus elaphus</i>

APPENDIX C

DATA SOURCES

Appendix C: Data Sources

1: Field Data for Anaconda Uplands Injured Areas (2001) formatted as compact disk (CD).

- a) 01/02/02a. Final Stucky Ridge/Smelter Hill Polygon Data (Cover class by species by polygon).
- b) 01/02/02b. Final Stucky Ridge/Smelter Hill Summary Data (Dominant ground cover, dominant vegetative cover, erosion type, browse, microsite availability, others).

2: Photographic Data for Anaconda Uplands Injured Area Spring/Summer 2000/2001. Submitted in supplemental binder.



